United States Department of the Interior

FISH AND WILDLIFE SERVICE

KLAMATH BASIN NATIONAL WILDLIFE REFUGES
4009 HILL ROAD
TULELAKE, CALIFORNIA 96134

TELE: (530) 667-2231

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Dear Interested Party:

June 4, 2002

The National Wildlife Refuge Administration Act of 1966 and the recently enacted Refuge Improvement Act of 1997 mandate that all system uses on National Wildlife Refuges (NWRs) must be compatible with the primary purposes for which the refuge was established and the mission of the National Wildlife Refuge System. In addition, the Kuchel Act of 1964 mandates that commercial agriculture on Tule Lake and Lower Klamath NWR be consistent with the primary purpose of waterfowl management. The Service views the two standards expressed in these laws as synonymous and applicable to the farming program.

The U.S. Fish and Wildlife Service (Service) prepared a Compatibility Determination (CD) in 1994 which determined that farming on the Refuges was compatible and consistent, with stipulations, with the primary purposes for which Tule Lake and Lower Klamath NWR were established. The 1994 CD has been re-certified annually through 1998. However, the 1994 CD did not consider impacts of water shortages to Refuge wetlands. Water planning in 1997-98 as part of the Bureau of Reclamation's 1998 Klamath Project Operations Plan and more recent analysis by Service hydrologists indicate that water shortages to Refuge wetlands could be expected in a large proportion of future years. Potential impacts to biological resources on Tule Lake and Lower Klamath NWRs are substantial. This necessitated a re-evaluation of how water is used on the Refuge, particularly if water is used in Refuge farmlands that could otherwise be used in Refuge wetlands in years of limited water supply. In February of 1999, the Service completed a new CD. The 1999 CD concluded that the Refuge farming program was compatible and consistent (with stipulations) with the primary purposes for which these two refuges were established and the mission of the Refuge System, only if sufficient water was available to maintain wetlands first, followed secondarily by water for use on agricultural habitats. Options for implementing the CD were released for public comment in the form of a Discussion Paper on March 15, 1999. Comments received from the Discussion Paper, discussions with Tule Lake Irrigation District and internal scoping were used to prepare a range of Alternatives in a Draft Environmental Assessment (EA) issued on January 19, 2001.

Based on comments received on the Draft EA and further analysis of water availability to Refuge wetlands under the 1999 CD, the Service has decided to select the No Action Alternative within the EA. During the fall of 2000, it became apparent that during drought conditions return flows generated from Klamath Project irrigation including the leased lands on Tule Lake NWR, may not be available for use on Refuge wetlands as previously assumed by the Service.

Because wetlands on the Refuges are extremely important for numerous fish and wildlife species, the Service has filed water rights claims in the Oregon Klamath Basin adjudication. The State of Oregon has preliminarily approved these claims in its Summary and Preliminary Evaluation of Claims. Until

the Oregon adjudication is completed, Tule Lake and Lower Klamath NWR water use for Refuge wetlands is subject to the water needs of Endangered Species Act (ESA) listed species, tribal trust, and Klamath Project agriculture (including Refuge lease lands). From a refuge management perspective, wetlands rather than agricultural fields are a higher priority as waterfowl habitat. However, even if the Service were to curtail farming on Tule Lake or Lower Klamath NWR during periods of water shortage, it is assumed that any water savings would not likely be available for refuge wetland use.

Because of a reassessment of the water issue and new biological information that has been gathered since 1994, the Service is in the process of preparing a new CD consistent with our obligations under the Refuge Administration Act and the Kuchel Act. This new CD is expected to cover the years 2003 and beyond. Until this document has been prepared, reviewed by the public, and been subject to environmental compliance, the Service has rescinded the 1999 CD and will operate under the 1994 CD.

Attached is a signed Finding of No Significant Impact (FONSI) associated with this decision. The Draft EA has not been modified to incorporate public comments, other than to attach an appendix which analyzes the summarized comments of all the entities that responded. A copy of this appendix is also attached.

A full copy of the Draft EA, along with these documents can be accessed via the Refuge website at www.klamathnwr.org.

Sincerely,

Philip W. Norton,
Project Leader

FINDING OF NO SIGNIFICANT IMPACT

Implementation of an Agricultural Program on Tule Lake National Wildlife Refuge

Klamath Basin National Wildlife Refuge Complex
4009 Hill Road
Tulelake, California 96134

The U.S. Fish and Wildlife Service proposes to continue the farming program on Tule Lake National Wildlife Refuge in a manner that is consistent/compatible with the Kuchel Act of 1964 and the National Wildlife Refuge System Administration Act of 1966, as amended pursuant to the 1994 Compatibility Determination (CD). As such, the Service has selected the No Action Alternative in the Environmental Assessment (EA): *Implementation of an Agricultural Program on Tule Lake National Wildlife Refuge.*

Tule Lake NWR consists of 39,116 acres of which 15,500 are leased to local farmers under a program administered by Reclamation via a 1977 Cooperative Agreement with the Service. The Kuchel Act provides that agricultural leasing on Refuge lands must be consistent with proper waterfowl management. Leasing is by competitive bid and leases are awarded in five-year increments with the option to renew each year. Approximately 20% of the leases are put out for bid each year with the remaining approximately 80% available for renewal. Leased lands are comprised of 168 lots ranging from 60-120 acres each. Primary crops include barley, oats, wheat, sugar beets, onions, potatoes, and alfalfa. Barley, wheat, and oats comprise most of the acreage with potatoes the dominant row crop.

During the irrigation season (April - September) the farming program on Tule Lake receives most of its water via return flows from "upstream" irrigation districts as well as Tule Lake Irrigation District (TID) itself and consumes approximately 35,000 acre-feet of water during this time period. As such, the farming program on Tule Lake NWR may be "intercepting" return flows that would be needed on Refuge wetlands (both Tule Lake and Lower Klamath NWRs) in years of insufficient water supply. The potential for impacts to waterfowl and other wildlife associated with reduced water supplies to Refuge wetlands necessitated a re-evaluation of the Refuge's agricultural program (lease lands and cooperative farming) relative to its consumption of water in years of insufficient supply. Options to implement changes to the farming program were released for public comment in the form of a Discussion Paper on March 15, 1999. Comments received from the Discussion Paper, discussions with Tule Lake Irrigation District and internal scoping were used to prepare a range of Alternatives in a Draft EA issued on January 19, 2001.

In its hydrologic analysis within the EA, the Service assumed there were no limitations to using the water "savings" from a curtailed farming program on Tule Lake NWR. Thus, excess return flows from Tule Lake NWR would be used to flood and maintain wetland habitats on Tule Lake

and Lower Klamath NWR, as had traditionally occurred in the past. The Service views maintaining wetland habitats as its first priority for meeting legislated refuge purposes under the Kuchel Act as well as establishing Executive Orders. However, the Kuchel Act provides that farming should occur to the extent it is consistent with the primary purpose of waterfowl management. The key assumption in the 1999 CD regarding water availability for refuge use if farming were curtailed proved to be inaccurate. Water savings from curtailed agricultural use is distributed based on legal obligations that take priority over refuge deliveries.

In light of the above, the Service proposes to continue the present farming program (No Action Alternative) while it re-evaluates refuge wildlife habitat and related water issues and new biological information that has been gathered since 1994. The Service is considering preparation of a new CD for the farming program on Tule Lake and Lower Klamath Refuges, which would cover the years 2003 and beyond. Until this document and any associated environmental compliance documents have been prepared and reviewed by the public, other agencies, and Tribes, the Service will continue to operate according to the 1994 CD. Measures to ensure compatibility of the Refuge farming program which are included in the 1994 CD include implementation of an Integrated Pest Management Plan (IPM), continued application of the Pesticide Use Proposal (PUP) process, evaluation of the "Integrated Land Management" concept, weed control and cover establishment, fall work, and burning on agricultural lands. An IPM plan and associated NEPA document to address these measures was completed in 1996.

FWS has analyzed a number of alternatives to the proposal including the following:

1. No Action - Continuation of current farming program prior to 1999 CD (under the 1994 CD).

   The current farming program is briefly described above and in more detail in the subject EA.

2. Alternative 2 - farming consistent with 1999 CD - potential for mid-growing season irrigation curtailment.

   As a first decision point for leasing, the Service would use the Natural Resource Conservation Service's (NRCS) February 1st forecast at the 70% exceedance level as an estimate of inflows to Upper Klamath Lake during the irrigation season. This value would be used to determine if wetland shortages are likely in the coming summer/fall season. An initial decision to lease would be made on or about February 10th. A decision not to allow April to September irrigations based on the February 1st NRCS forecast could be reversed if the April 1st forecast at the 50% exceedance level indicated that sufficient additional water supplies had accumulated during February and March to serve both Refuge agricultural programs as well as Refuge wetlands. The decision to lease based on the April 1st NRCS forecast would be made on or about April 10th. If, later during the growing season, conditions became drier than forecast and Refuge wetlands experience water shortages, the leased land program would be curtailed mid-season to potentially make water available for Refuge wetlands.

3. Alternative 3 (Preferred) Farming consistent with 1999 CD - No mid-growing season irrigation curtailment.

   Alternative 3 is identical to Alternative 2 except once the decision to proceed with the leased land program is made, there would be no potential for mid-season curtailment of irrigation water to the farming program.

Alternative 1 (No Action) proposal was selected over the other alternatives because:

1. The key assumption in the 1999 CD regarding water availability for refuge wetlands, if farming were curtailed, may not have been accurate. An improved understanding of TIDs operations and water delivery patterns during recent drought events have strongly indicated that water "savings" from a reduced irrigation program on Tule Lake NWR would simply make more water available to other prioritized needs. Also, there is additional information on waterfowl numbers, drought conditions, pesticide use and other impacts to migratory waterfowl that were not fully considered in the 1999 CD.

2. Curtailing the lease program may result in large weed infestations on the lease lands (as occurred in 2001). Weed infested fields are seldom used by fall migratory waterfowl.

3. In addition, curtailing the farming program for unlikely benefit, in terms of water savings, may compromise working partnerships with Tule Lake Irrigation District and other Basin farm interests. Through these partnerships, the Service has recently restored or enhanced approximately 5,000 acres of Tule Lake NWR wetlands and additional funding has been obtained to develop alternative water supply sources.

Implementation of the selected alternative (No Action) would be expected to result in the following environmental and socioeconomic effects:

1. Because of the Refuge's legal priority for water, its position within the Klamath Project, TIDs operation, and the uncertainty in water supply forecasts, implementation of the No Action Alternative is not expected to result in water consumption by the agricultural program that could otherwise be used in refuge wetlands.

2. Would result in more agricultural foods for waterfowl on Tule Lake NWR compared to the other 2 alternatives, thus reducing the distance waterfowl must travel for these foods while reducing the potential for smaller populations of waterfowl using Tule Lake NWR.

3. Would result in the smallest acreage of potential weed infestations compared to the other 2 alternatives, thus reducing the economic impact of controlling excess weeds.

4. Would result in the smallest potential for crop depredation on private lands by increasing the availability of agricultural foods on Tule Lake NWR.

5. Would result in the smallest economic impacts to local counties and communities primarily

through continued production of agricultural commodities and the availability of lease revenues.

Measures to mitigate and/or minimize adverse effects of selecting the No Action Alternative have been incorporated into the proposal. These measures include:

1. Measures identified through prior consultations under Section 7 of the Endangered Species Act will continue to be incorporated. These measures are intended to protect the shortnose and Lost River sucker and bald eagle and include:

   a. Minimum water levels in the Sumps by time period to lessen potential impacts of poor water quality on the endangered suckers.

   b. Implementation of the Sump 1(B) project to improve habitat and foraging opportunities for waterfowl and bald eagles and improve water quality conditions for the endangered suckers.

   c. No spray (pesticides) buffer zones adjacent to water to minimize spray drift into sucker bearing waters.

2. Measures identified in the leasing process to minimize adverse effects will continue to be implemented.

   a. Implementation of the Integrated Pest Management Plan to minimize use of pesticides thereby minimizing potential impacts to listed species as well as other biological resources.

   b. Continued monitoring of potential pesticide effects to the Refuge's fish and wildlife populations. This will ensure that currently unforseen pesticide impacts are detected and eliminated.

   c. Limited burning and tillage periods and planting of cover crops to reduce sedimentation in Refuge wetlands.

3. Compliance with archeological/historic preservation laws to prevent damage to culturally significant sites.

Implementation of the No Action Alternative is not expected to have any significant effect on the human environment because:

a. Rural agricultural economies will be unaffected.
b. Consumptive and nonconsumptive visitor use of Tule Lake NWR will remain stable.
c. Water quality and habitat conditions will be enhanced through cooperative wetland enhancement and restoration efforts with TID and Reclamation. Efforts currently underway have restored or enhanced approximately 5,000 acres on Tule Lake NWR.

d. Agricultural foods for waterfowl will be unaffected.
e. Crop depredation to private lands will remain at current levels as production of agricultural foods on the Refuge should provide adequate food resources for waterfowl, as has occurred in the recent past.

The proposal has been coordinated with all interested and/or affected parties. The following parties were sent copies of the draft EA or submitted comments on the document:

Organizations/Agencies:

A Hunter's Voice
American Lands Alliance
Audubon Society of Corvallis
Audubon Society of Portland
Audubon Society of Salem
Headwaters
Kettle Range Conservation Group
Klamath Siskiyou Wildlands Center
Modoc County Board of Supervisors
National Wildlife Refuge Association
Northwest Environmental Defense Center
Oregon Natural Resource Council - on behalf of the following organizations:
- Butte Environmental Council
- Cape Arago Audubon Society
- Cascadia forest Alliance
- Conservation Committee
- Constitutional Law Foundation
- Friends of Del Norte
- Juniper Group Sierra Club
- Kalmiopsis Audubon
- Klamath Forest Alliance
- Mazamas
- North Group
- Northcoast Environmental Center
- Oregon Natural Desert Association
- Oregon Watersheds
- Pesticide Action Network
- Pesticide Watch
- Redwood Chapter Sierra Club
- Rogue group Sierra Club
- Save the West, Inc,.
- Siskiyou Regional Education Project
- Soda Mountain Wilderness Council

Umpqua Watersheds, Inc.
Sierra Club, Oregon Chapter
Siskiyou County Board of Supervisors
Siskiyou County Farm Bureau
Tule Lake Irrigation District
University of California, Intermountain Research and Extension Center
U.S. Bureau of Reclamation

J&W Walker Farms, Inc.
Water Watch (on behalf of Klamath Forest Alliance)
The Wilderness Society
Wildlife Management Institute

Individuals:

Mary Allardt-Wong
Janet Allen
Susan Applegate
Barbara Ballou
Pat Clancy
Jan Conley
Tammie Cramey
Susan Delles
Linda Das
Vicki Dern
Francis Eatherington
Alice Elshoff
Myra and Alan Erwin
Arthur M. Farley
Erik Fernandez
William W. and Juanita A. Forester
Teresa Giacomini
Kevin Gorman
Doug Heiken
Charlotte Horning
F. Ingram
David A. Inholt
John Koenig
David Krizo
Lyn Larson
Walter Lindley
Jim Low
Erin Madden
Judith L. McClure
Kathryn McKenzie
Simone McKenzie
Mark MacDonald
Brandt Mannchen
Chuck Mitchell
Susan Nutley
Frances Petschek

John and Sandra Potter
Jen Punzel
Peggy Risch
Bill Sefler
Rosie Seymour
Terence M. Shumaker
Leeanne Siart
Karen Sjogren
Mort Smith
Richard Spotts
Thomas Stanley
Josh Strange
Mary Ellen Sweeney
John Taylor
Merle and Marjorie Turner
Joanne Vinton
Sigmid G. Weidenweber
Sally Wells
Dee White

Michael T. Williams
Nancy Zierenberg

Therefore, it is my determination that the proposal does not constitute a major Federal action significantly affecting the quality of the human environment. As such, an environmental impact statement is not required. A environmental assessment has been prepared in support of this finding and is available upon request to the FWS facility identified above.

Reference: Implementation of an Agricultural Program on Tule Lake National Wildlife Refuge

Steve Thompson
California/Nevada Operations Manager

5/28/2002
Date

U.S. FISH AND WILDLIFE SERVICE

Environmental Action Memorandum

Within the spirit of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA) and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and have determined that the action of :

Implementation of an Agricultural Program on Tule Lake National Wildlife Refuge

is found not to have significant environmental effects as determined by the attached Environmental Assessment and Finding of No Significant Impact.

Other supporting documents:

Biological Opinion (Compliance with Section 7 of the Endangered Species Act)

Recommended:

(1) _____ 4/9/02
Project Leader *Date*

(2) _____ 5/28/02
Refuge Supervisor *Date*

Approved:

(1) _____ 5/28/2002
California/Nevada Operations Manager *Date*

Comments and responses concerning Draft Environmental Assessment for Implementation of an agricultural program on Tule Lake National Wildlife Refuge

A draft Environmental Assessment (EA) was sent to interested parties on January 19, 2001 with an open comment period to February 20, 2001. This comment period was extended to March 5, 2001. In addition to mailings, the EA was also posted on the Refuge website.

A total of 79 written comments were received relative to the draft EA. Twenty-two letters were from organizations or local governments. Most letters represented their respective groups, however, one letter represented comments from an additional 23 organizations. An additional 57 letters of comment from individuals were also received. Of the comments received, five supported Alternative 1, 75 supported Alternative 2 and no individuals or organizations supported Alternative 3. Three organizations supported Alternative 1 with modifications (Service should adopt Alternative 1 and participate in mediated negotiations to resolve water problems on the Refuges).

The draft EA was not amended, however, the Service has attempted to provide answers to the comments received. Only substantive comments were addressed. Comments were paraphrased and grouped for ease of review and response.

Comment 1: Commercial farming on the Refuge is not compatible with Refuge or Refuge system purposes as stipulated under the 1966 National Wildlife Refuge Administration Act as amended by the 1997 National Wildlife Refuge Improvement Act and should be eliminated.

Response: Elimination of the leasing program itself was not within the scope of the EA. The EA was written to evaluate implementation of the 1999 CD which found that the commercial farming program is compatible with stipulations and an adequate supply of water for Refuge wetlands.

Comment 2: Refuge farming is using scarce water that is needed for Refuge wetlands.

Response: The Service filed water rights claims in the Oregon Klamath Basin adjudication. The State of Oregon has preliminarily approved these claims in its Summary and Preliminary Evaluation of Claims. However, until the adjudication is complete, Endangered Species Act (ESA) listed species, tribal trust, and Klamath Project agriculture (including Refuge leased lands) water needs take precedence over water use for refuge wetlands (these priorities are described in a July 25, 1995 Solicitor's Opinion). Recent analysis as part of Klamath Project planning, indicates that wetlands on both Refuges may be short of water in a large proportion of future years. The exact degree of shortage will depend on water needs of ESA listed species, demand by Project agriculture, and the water year type. From a refuge management perspective, wetlands rather than agricultural fields are a higher priority as waterfowl habitat. However, even if the Service were to curtail farming on Tule Lake or Lower Klamath NWR during periods of water

shortage, it is assumed that the water savings would be distributed based on legal obligations that take priority over refuge deliveries.

Comment 3: The Service should eliminate crops not directly beneficial to waterfowl. Respondents generally targeted row crops or more specifically sugar beets and onions and used the 1994 Compatibility Determination as a basis for this response.

Response: Refuge biologists have conducted goose use transects in the leased lands for the last four years. Results from these surveys indicate that potatoes, either alone or with a fall planted cover crop are consistently preferred (compared to other crops in the leased lands) by Refuge geese. Onions and sugar beets, in general, are used in proportion to their availability with other crops in the leased lands.

When discussing agricultural habitats for waterfowl and other wildlife it is important to note that rarely do these habitats provide the full nutritional needs or habitat requirements. In the case of waterfowl, Canada, snow, Ross, cackling, and white-fronted geese as well as mallards, pintails, and wigeon are the primary waterfowl species using agricultural areas on Tule Lake and Lower Klamath NWRs. Although these species utilize agricultural crops, wetland habitats are crucial to these species existence. Geese use wetlands for roosting and to obtain supplemental food resources and mallards and pintails make extensive use of seasonal and permanent marsh habitats for a variety of food resources including aquatic invertebrate, submergent plants, and seeds. Other waterfowl species such as gadwall, green-wing teal, shoveler, redhead, canvasback, lesser scaup, cinnamon teal, ring-neck, common goldeneye, ruddy duck, bufflehead, and common merganser use agricultural lands rarely if at all. In addition to waterfowl, a multitude of other wetland bird, reptile, amphibian, and mammal species are likewise dependent on Tule Lake and Lower Klamath NWRs wetland habitat for food, survival, and reproduction. Agricultural crops left in harvested or unharvested fields, however, are a high energy seasonally available food for the above-mentioned waterfowl species. Geese use a combination of small grains and row crops (primarily potatoes) while ducks use small grains.

From 1997 to 1999, Refuge biologists conducted crop preference transects for geese on the Tule Lake NWR leased lands (Table 1). Chi-square analysis was used to determine if geese used different crop types in proportion to their availability.

Table 1. Chi-square analysis of fall (Oct-Dec) goose use by crop type on Tule Lake National Wildlife Refuge, California, 1997-99.

Crop	Canada	Cackling	White-front	Snow/Ross'	All
Barley	Avoid	–	–	Prefer	Avoid
Oats	–	Avoid	–	Avoid	Avoid
Wheat	–	–	–	–	--
Potatoes	–	–	–	–	--

Potatoes (fall cover cropped)	Prefer	Excluded	Excluded	Excluded	Prefer
Onions	–	–	Avoid	Avoid	--
Onions (fall cover cropped)	–	–	–	Excluded	--
Sugar beets	–	–	–	–	--
Sugar beets (fall cover cropped)	Prefer	Prefer	Prefer	–	Prefer
Alfalfa	Avoid	Avoid	Avoid	Avoid	Avoid
Winter wheat (green forage)	Excluded	Excluded	Excluded	Excluded	Avoid

Prefer = Observed in crop type significantly more often than expected by chance.
Avoid = observed in crop type significantly less often than expected by chance.
– = Observed in crop type as often as expected by chance.
Excluded = Number of expected observations too low to be included in analysis.

Results from these transects indicate that all crops (including row crops), with the exception of alfalfa (which was avoided) were either preferred or used in proportion to availability by at least one species of goose or the overall goose assemblage. It was especially notable that planting of fall cover crops in row crop fields (especially potatoes and sugar beets) increased use of these fields. Much of the decline in goose use of alfalfa/winter wheat is probably due to the loss of fall staging cackling Canada geese which now utilize the Williamette Valley of Oregon.

The Service believes that altering the present pattern of leasing by placing additional restrictions on row crop types or acreage will not result in increased waterfowl use. Increased waterfowl use of Tule Lake NWR will only occur when the quality and diversity of wetland habitats is improved. Major efforts to develop adequate quantity, quality, and diversity of wetland habitats on the refuge are currently underway. However, available water supplies put limits on the acreage and locations for wetlands. The Service is working with Tule Lake Irrigation District (TID) and the U.S. Bureau of Reclamation (Reclamation) on several projects to create new wetlands and enhance existing wetlands. Over the last five years, one thousand six hundred acres of wetlands have been created on the leased lands and 3,500 acres of wetlands have been enhanced via cooperative projects with the above agencies.

Comment 4: Pesticide use on the Refuge should be severely reduced or eliminated as per the Service's own policy.

Response: Pesticide applications to all Refuge farm lands must adhere to Interior and Service Policy which includes preparation and approval of Pesticide Use Proposals prior to any pesticide applications. In addition, an Integrated Pest Management Plan has been implemented which guides future agricultural operations to minimize use of pesticides and improve the long-term

sustainability of the Refuges' agricultural program. This plan is described in more detail in the Integrated Pest Management Plan and Environmental Assessment available from: Refuge Manager, U.S. Fish and Wildlife Service, Klamath Basin NWR, 4009 Hill Road, Tulelake, CA 96134.

Although current studies and monitoring activities have failed to detect a significant acute problem with pesticides on the Refuge, the occurrence of chronic or sublethal effects is more difficult to detect. For that reason, an IPM plan was implemented in 1998 and a Pesticide Use Proposal (PUP) process was established to evaluate the specifics of proposed chemicals, treatment sites, application method, and sensitive aspects of use. The decision to approve or disapprove a new chemical is based on extensive toxicity data, proposed use of the pesticide, environmental conditions, degradation rates, solubility, and availability of other cultural, biological, or less toxic alternatives. In addition, the Service has established no-spray zones within 300 feet of the Sumps and 50 feet within any water bodies on the Refuges.

Comment 5: Farm lands should be replaced with wetland habitats or other habitats more beneficial to wildlife.

Response: Wetland habitats will always be the primary habitat need for waterfowl and other wetland wildlife on Tule Lake and Lower Klamath NWRs. However, available water supplies and the Kuchel Act as currently administered put limits on the acreage and locations for wetlands. The Refuge is working with TID and Reclamation on several projects to create new wetlands and enhance existing wetlands, particularly on Tule Lake NWR. One thousand six hundred acres of wetlands have been created on the leased lands over the last several years and 3,500 acres of wetlands have been enhanced via cooperative projects with the above agencies. Farmers support this large acreage of wetlands in farmed areas because field trials have shown that wetlands within the farm lands, besides being very valuable for wildlife, enhance soil fertility and reduce soil pests. Wetlands within the farm lands is now accepted as a key IPM technique to reduce or eliminate pesticide and fertilizer inputs.

Comment 6: Refuge farming negatively affects water quality.

Response: Water quality within the Tule Lake and Lower Klamath NWRs reflect the water quality of other water bodies up gradient of the Refuges, such as Upper Klamath Lake. Summer water quality frequently experiences periods of low dissolved oxygen (DO), high pH, and high levels of un-ionized ammonia. Extensive hydrologic modifications of the Klamath Basin (of which the Refuges are a part) has degraded aquatic habitats and associated biological communities. Specifically, fish and aquatic invertebrate species assemblages retain little of their historic ecological structure and are now represented primarily by pollution-tolerant species.

Water quality problems are a Basin-wide phenomenon. Irrigation water reaching the Refuges has been used and re-used multiple times. Thus, eliminating Refuge farming is unlikely to significantly improve water quality conditions. To address this problem, the Service is

considering a reconfiguration of Refuge habitats such that the natural water quality improvement function of wetlands can be used to improve water quality on the Refuge and at points downstream.

Comment 7: Refuge farming occupies areas that could be used for water storage or winter flooded wetlands.

Response: In addition to the response to Comment # 5, the Refuge is working with TID to improve winter water storage capability and the ability to winter flood agricultural lands. Winter irrigation is beneficial to waterfowl and wintering eagles and is used extensively on Lower Klamath NWR as a wildlife management practice. In addition, winter irrigation lessens the overall water demand in the Klamath Project and ensures that grain crops can be grown in the subsequent year, thus ensuring food for fall migrant waterfowl and weed control in agricultural fields.

Comment 8: The farming program prevents restoration of "normative" hydrology on the Refuge.

Response: Tule Lake and Lower Klamath NWRs are integral parts of the Klamath Reclamation Project and were not formally established until after the Project was initiated. This is important for 2 reasons. First, the "normative" hydrology of the Basins in which the Refuges exist has been replaced by Project infrastructure (canals, drains, etc). Second, water is typically not available to meet Refuge purposes until after agricultural purposes of the Project have been met. Given these, not unsubstantial limitations, the Refuge does attempt to mimic this "normative" hydrology to the extent possible through both fall, winter, and spring wetlands and maintenance of year-round wetlands.

Comment 9: The farming program contributes to sedimentation in Refuge wetlands.

Response: Sedimentation in Refuge wetlands, particularly on Tule Lake NWR, reduces the attractiveness of wetland habitats for waterfowl and reduces water depth needed by fish. Sedimentation on the Refuge has three sources including wind blown soil from farm lands, sediment transported via Lost River, and decomposition of aquatic plants within the marsh. By far, the greatest source of sediment emanates from private lands along the Lost River above the Refuge. Practices are currently in place on Refuge farm lands to reduce soil erosion. These practices include cover cropping in row crop lands, leaving grain stubble on the fields for as long as possible, and winter irrigation where possible. From a wetland habitat perspective in the short-term, the Service is enhancing or creating several thousand acres of wetlands on Tule Lake NWR (see response to Comment #5). In the long-term the Service is exploring options to alleviate this problem as well as others through a reconfiguration of habitats within the Refuge.

Comment 10: Farming on the Refuges contributes to the overall agricultural demand in the Klamath Project and therefore competes with Refuge wetlands for scarce water supplies.

Response: Refuge farming comprises approximately 9% of Project acreage and about 4-5% of total watershed agricultural acreage. The Service in cooperation with TID is seeking ways to increase winter irrigation on Refuge farmlands. This will have the effect of directly reducing the overall Project demand, thereby indirectly increasing spring/summer water supplies for Refuge wetlands. Because only a relatively small proportion of the Project and watershed agricultural demand is on the Refuge, eliminating Refuge farming will result in only a small reduction in overall agricultural water demand.

Comment 11: The EA does not address the role of farming in the overall wildlife management program on the Refuge.

Response: The scope of the draft EA was to address implementation of the 1999 CD and explore alternatives under which the agricultural program would be curtailed to provide water to wetland habitats.

Agricultural habitats and how they are managed have value to certain species of wildlife. Waterfowl, especially geese, are particularly attracted to agricultural lands during migration and a variety of wintering raptors, including bald eagles, forage on waterfowl and small mammals in these areas. Cultural practices such as burning and irrigation can be used to further enhance the value of these lands to wildlife. An interspersion of agricultural lands within a varied complex of wetlands in particular is attractive to large waterfowl populations. Despite the value of agricultural lands, however, wetlands remain the primary habitat for the greatest range of waterfowl species.

Comment 12: Waterfowl are not dependent on grains or other Refuge crops.

Response: To maintain relatively high waterfowl populations within a significantly reduced wetland base in the Klamath Basin (60-80% loss) and the State of California (90-95% loss) requires that supplemental food sources other than natural food items be available. In the Klamath Basin, these supplemental food sources are primarily grain and potatoes. In the primary wintering areas of California's Central Valley these foods are corn and rice. To the maximum extent possible, Refuge managers attempt to provide as much natural foods as possible within existing constraints, such as water and habitat availability.

Comment 13: Agriculture does not benefit all waterfowl species.

Response: True, agricultural crops primarily benefit snow, Ross, white-front, Canada, and cackling geese, and mallards, pintails, wigeon, wood ducks, and tundra swans. Other species such as mergansers, gadwall, green-wing teal, shovelers, redhead, scaup, and canvasback consume agricultural foods rarely if at all. Non-agricultural waterfowl foods (seeds, aquatic invertebrates, fish, and marsh plants) are provided from approximately 10,000 acres of year-round flooded wetlands and 4,600 acres of seasonally flooded wetlands on Tule Lake NWR. Lower Klamath NWR contains an additional 30,000 acres of wetland habitats available to

wildlife. In addition to waterfowl, a host of other wetland dependent wildlife also utilize the Refuges' wetland habitats.

Comment 15: The biological potential for Tule Lake NWR cannot be realized until farming is eliminated.

Response: The Service believes that the biological potential of the Refuge can be reached primarily through enhancement of existing and creation of new wetlands on Tule Lake NWR. These actions are already underway (see response to Comment #5). As these developments occur, the farming program will be re-evaluated and adjusted accordingly taking into account the Kuchel Act and water availability.

Comment 16: The EA should be stronger in its description of habitat needs for bald eagles.

Response: In general, there are 3 key wintering sites for bald eagles in the Klamath Basin. These include Lower Klamath and Tule Lake NWRs and Klamath Drainage District lands north of Lower Klamath NWR. Over the last 10-20 years most wintering eagle use (60-80%) has been focused on Lower Klamath NWR, primarily because of the greater numbers of waterfowl present. Recent wetland enhancement and restoration of wetlands on Tule Lake NWR appears to be increasing eagle numbers on this Refuge as well. The primary food source for wintering eagles in the Klamath Basin is waterfowl that remain on the Refuges through the winter period. A variety of seasonal and permanent wetland habitats are required to attract waterfowl that then become prey for eagles when they begin arriving in winter. A more detailed description of habitat needs for wintering eagles in the Klamath Basin can be found in the 2001 Klamath Project Biological Opinion which is available from the U.S. Fish and Wildlife Service, 6610 Washburn Way, Klamath Falls, Oregon 97603.

Comment 17: There is no legal basis to assume that unused return flows can be used by the Refuge for wetland habitats.

Response: The Service had assumed in development of the draft EA that return flows generated from a curtailed agricultural program could be used to flood and/or maintain wetlands on Tule Lake and Lower Klamath NWR. Traditionally, return flows from the Tule Lake sumps have been the largest source of water for wetlands, particularly on Lower Klamath NWR. Events such as those that occurred during the fall of 2000, cast doubt on this assumption because it appears that future shortages will be more frequent and greater in magnitude such that the Refuges may not be able to use any such flows for Refuge wetlands.

Comment 18: Water shortages and other management issues on Refuges would be best dealt with in negotiated mediation with other interested parties in the Basin which could result in legislated solutions to Refuge problems.

Response: The Service is actively involved in discussions on several fronts to arrive at Basin

solutions.

Comment 19: Shutting off water would result in an increased financial obligation of TID to the Federal Government.

Response: Since the Service is selecting the No Action Alternative, it is not proposing to shut off water to the leased lands.

Comment 20: The Service's authority to effectuate water movement to Lower Klamath NWR not clear.

Response: The Service assumed that removal of return flows to maintain water levels in the Tule Lake sumps by TID (as a Reclamation contractor) would provide water needed for Lower Klamath wetlands. Essentially, a curtailed leasing program would result in increased pumping from Tule Lake sumps by necessity.

Comment 21: Described use of Clear Lake water in Chapter 2 is questionable given the limitations of the system.

Response: The Service believes that in certain years when agricultural demands have been satisfied, Clear Lake water could be made available for fall flooding of Refuge wetlands. Water could be released from Clear Lake and diverted from Station 48 to the Lost River and on to Tule Lake. Primary facilities to conduct this operation are owned by Reclamation and operated under contract with several irrigation districts.

Comment 22: The EA needs to address impacts from both dry farmlands and dry wetlands.

Response: Because water saved from a curtailed farming program could instead be used by more senior water uses, this scenario is a very real possibility under Alternative 2 and 3. Under these alternatives, leased land farming could be curtailed potentially making return flows available, however, these return flows would likely go to more senior water uses and not necessarily Refuge wetlands. Thus the result of dry farmlands and potentially dry wetlands. Non-irrigated leased lands if planted with a small grain cover crop could provide adequate foods to migrant waterfowl, as occurred in 2001. If cover crops were not planted, however, waterfowl may fly off-Refuge to forage on private lands, potentially increasing depredation problems. Impacts of dry wetlands are described in Section 4.1.1 in the draft EA.

Comment 23: The EA fails to consider changes in TID's water management operations during periods of reduced water availability.

Response: A certain amount of water received by TID is uncontrolled return flows and spills from Klamath Irrigation District (KID). Other than fall, when KID is lowering canals, this quantity of water is less than TID demand. TID augments this supply by releasing water from the

Lost River Diversion Channel at Station 48. In 1992 and 1994, TID tightened its water management in summer such that no return flows were generated at D-Plant and little water was available for Lower Klamath NWR wetlands. If leased lands were curtailed, it is logical to assume that TID would modify its operation to minimize the generation of excess return flows.

Comment 24: Did peer review of the hydrologic analysis occur?

Response: Hydrologic analysis was conducted by Dr. Tim Mayer, Regional Hydrologist with the Service's Portland Regional Office. His work was reviewed by TID's contracting hydrologist as well as Reclamation hydrologists.

Comment 25: The discussion of ground water failed to address Modoc and Siskiyou County ordinances prohibiting exportation of ground water.

Response: The Service is not proposing to export ground water from Modoc or Siskiyou Counties.

Comment 26: Water should not be diverted from Refuge wetlands to crop lands.

Response: To the extent feasible under current water supplies and legal authorities, the Service places first priority on wetlands as wildlife habitat.

Comment 27: Some respondents felt that referring to some water as return flows and other water as direct deliveries was inappropriate because they felt all water essentially comes from Upper Klamath Lake.

Response: It is true that the primary source of water is Upper Klamath Lake, although Lost River water is also available at various times of the year.

Comment 28: Water saved in a curtailed leasing program would be diverted to higher priority Project water users.

Response: See Comment #17.

Comment 29: Higher exceedance values should be used in Alternative 2 and 3 to ensure the greatest probability of water for Refuge wetlands.

Response: Using higher exceedance values in Alternative 2 or 3 would have the effect of curtailing the leased land program in a greater proportion of years. However, given that the "excess" return flows generated would likely go to more senior uses, it is questionable whether using these higher exceedance values would result in greater certainty of water for Refuge wetlands.

Comment 30: The Refuge should exercise its 1905 water right and direct water away from farmlands to Refuge wetlands.

Response: This water right has not yet been adjudicated under the State of Oregon adjudication process. When water rights are adjudicated, the Service hopes to have more control on utilizing water in wetlands as a first priority.

Comment 31: Once water rights are adjudicated, water for agricultural lands should be used for other Refuge purposes.

Response: See response to Comment #30.

Comment 32: Commercial farming should be managed as a secondary use under the 1997 National Wildlife Refuge Improvement Act.

Response: The Service views agriculture as a secondary purpose on Tule Lake and Lower Klamath NWRs (as per the Kuchel Act). Although it is considered a purpose, it is still a "use" that is governed by the National Wildlife Refuge Administration Act as amended by the National Wildlife Refuge System Improvement Act. The Kuchel At provides that the Secretary shall continue the present pattern of leasing consistent with proper waterfowl management. In addition, it states that lands of the Tule Lake NWR , Lower Klamath NWR, Upper Klamath NWR, and Clear Lake NWR are dedicated to wildlife conservation and are to be administered for the major purpose of waterfowl management but with full consideration to agricultural use that is consistent therewith. The Kuchel Act establishes the specific requirement that agriculture be consistent with "proper waterfowl management". The Service has viewed consistency under the Kuchel Act to be synonymous with compatibility under the National Wildlife Refuge System Improvement Act and is using its compatibility process for the agricultural program.

Comment 33: There was insufficient time to prepare comments on the draft EA.

Response: This comment was voiced by several respondents. The official comment period was extended from February 20, 2001 to March 5, 2001.

Comment 34: The proposed action represents significant environmental effects. As such an Environmental Impact Statement (EIS) should be prepared.

Response: The Service proposes to continue the farming program on Tule Lake National Wildlife Refuge in a manner that is consistent/compatible with the Kuchel Act of 1964 and the National Wildlife Refuge System Administration Act of 1966, as set forth in the 1994 CD. It is the Service's determination that the proposed action (No Action Alternative) does not constitute a major Federal action significantly affecting the quality of the human environment. As such, an environmental impact statement is not required. A finding of no significant impacts (FONSI) is available upon request from the Refuge Manager, U.S. Fish and Wildlife Service, Klamath Basin

NWR, 4009 Hill Road, Tulelake, CA 96134.

Comment 35: A cost-benefit analysis is needed in the EA.

Response: In the Service's analysis of the socio-economic impacts of the three alternatives in both the EA and FONSI, we determined that these impacts would not be significant for the selected alternative (No Action Alternative) and, therefore, did not require further study.

Comment 36: The EA needs to include mitigation measures.

Response: Some measures to lessen impacts to the agricultural program were listed in Section 2.3 of the EA. Service policy currently prohibits use of "mitigation" to make a use compatible. If the proposed use cannot be made compatible with stipulations, the Service cannot allow the use.

Comment 37: Alternatives are outside existing law (Kuchel Act).

Response: The Kuchel Act established waterfowl management as the Refuges' primary purpose. The EA explores alternatives such that the Refuges' primary purpose is achieved.

Comment 38: The EA needs to address what happens under Alternative 3 if the water year becomes drier than expected.

Response: If leasing were allowed and later in the summer the Service was directed to curtail water for Refuge wetlands, curtailing the leased lands may result in additional water being available, however, this water savings would likely be directed toward more senior water uses. In short, it is likely that the decision to lease or not lease may have little if any effect on whether Refuge wetlands received water.

Comment 39: The Kuchel Act requires continuation of leased land farming as a Refuge purpose.

Response: See response to Comment #32.

Comment 40: The Kuchel Act spells out how leased land farming and waterfowl are compatible. There is no need for a Compatibility Determination.

Response: The Kuchel Act does not determine compatibility or consistency. The Service must make these determinations consistent with the standards provided in the Kuchel Act, as well as the National Wildlife Refuge Administration Act as amended.

Comment 41: The Service does not have authority to terminate the leased land program.

Response: Under the Kuchel Act, the Service does have the authority and is required to ensure

the leased land program agricultural program is consistent with proper waterfowl management. The Service has determined this requirement for consistency to be synonymous with our mandate that Refuge uses be compatible. Through our Compatibility Determination process, we have determined that at this time the agricultural program is compatible and consistent with proper waterfowl management.

Comment 42: Conflicts with local land use policies have not been addressed.

Response: The Service always strives to manage its lands consistent with local ordinances.

Comment 43: The EA fails to address the magnitude of the wind erosion potential.

Response: In 2001 without an irrigated farming program, erosion was negligible. Farmers established cover crops on former row crop lands and most grain stubble was left from the previous year. As a result of these actions, wind erosion from farmed areas was less than a typical spring when nearly all lands are cultivated.

Comment 44: The EA fails to address the magnitude of crop depredation problems that may occur on private lands.

Response: Due to a dry winter of 2000-2001 no water was available to Refuge crop lands. Farmers planted small grains in former row crop ground and some stubble areas. Although crops of little commercial value were produced, adequate quantities of small grains were produced for waterfowl which presumably would have provided adequate food resources to reduce depredation problems on private lands. The Service believes the potential for crop depredation on private lands was adequately addressed in the EA.

Comment 45: The EA fails to adequately describe how weed infestation would be handled if leased lands are not farmed.

Response: Without irrigation water in 2001, weed infestations on leased lands were extensive. Some farmers opted to control these weeds, others did not. Had the Service actively attempted to control weeds on the leased lands, costs for materials and manpower would have been great.

Comment 46: Fall planted cover crops seldom become established sufficient to prevent soil erosion. Irrigation or tillage practices may be more effective.

Response: Success of fall planted cover crops to control erosion have been limited primarily because of the late planting date. By the time row crops are harvested, it is often too late in the season for successful cover crop establishment. The Service is currently working with TID to expand the acreage of winter irrigated lands which is another method of controlling soil erosion.

Comment 47: An alternative should be developed which eliminates leased land farming. This

would give the Refuge more management flexibility.

Response: The Kuchel Act requires the Secretary to give full consideration to optimum agricultural use consistent with wildlife conservation and to continue the then-current pattern of leasing at Tule Lake and Lower Klamath NWRs consistent with proper waterfowl management. This is the legal framework within which the alternatives were developed.

Comment 48: Fertilizer use should be restricted or eliminated.

Response: The Service is currently developing experimental leases to get growers involved in both organic farming and low input farming programs. A major component of these leases is using wetlands within a farming program to enhance soil fertility while reducing synthetic fertilizer use.

Comment 49: The EA fails to address beneficial habitat projects on Tule Lake NWR and how these might be affected by implementation of the preferred alternative.

Response: See Comment #5. Curtailing leasing as proposed under Alternative 3 would likely jeopardize working relationships with TID and nullify wetland creation and enhancement projects on Tule Lake NWR.

Comment 50: The EA does not address the loss of waterfowl habitat on the leased lands, ie canals, food and habitat, dust and air quality, increased pest and rodent populations and increase use of pesticides, effects to ESA listed species, and forfeiture of prime farmlands.

Response: If leasing were curtailed as per Alternative 3, there may be a loss of waterfowl habitat on Tule Lake NWR as weed infested fields (as experience in 2001) are not used by waterfowl. It was initially assumed that these losses and other potential impacts would be overcome by the benefits of additional water made available for Refuge wetlands. As discussed in response to Comment #2, additional water generated by Alternative 3 for Refuge wetlands is unlikely and this is one of the reasons the Service selected the No Action Alternative in the EA.

Comment 51: The loss of leased lands will negatively effect wildlife.

Response: If no stewardship occurred in the leased lands such as cover crop plantings (as occurred in 2001) it is likely that all fields would become weed infested and be of no value to wintering waterfowl. Cover crop plantings in 2001, particularly in former row crop fields (moisture was greatest in these areas) was successful in providing foods for waterfowl.

Comment 52: An analysis of socio-economic impacts should not be included in the document.

Response: The Service felt it was appropriate to address socio-economic impacts as part of the EA.

Comment 53: The value of the Refuges to environmental groups needs to be accurately portrayed.

Response: Klamath Basin NWR are of national significance, not only to migratory birds, but to several environmental organizations. The following organizations have designated Klamath Basin NWRs as such:

Wilderness Society	Within the top 15 most endangered wildlands in the U.S.
Sierra Club	Endangered lands that must be saved from further degradation.
Audubon Society	One of 10 Refuges in crisis

Comment 54: The estimated socio-economic impacts under Alternative 3 are understated. Huge impacts to local communities would result from a curtailed leased land program with little or no benefits to wildlife.

Response: The Service believes that socio-economic impacts of a curtailed leased land program were addressed accurately and with an adequate level of detail for an EA.

Comment 55: The estimates of visitor use area speculative.

Response: Klamath Basin NWR has two Interpretive Specialists on staff who summarize visitor use each year. Their 1997 Public Use Report was used to generate visitor use figures for the EA. The Service is unaware of any other visitor use estimates that are available.

Comment 56: The visitor use of the Refuge, if farming were curtailed is down-played.

Response: See Comment #55. The Service believes estimates of impacts to visitor use are the best that are currently available.

Comment 57: Waterfowl hunting opportunities would be degraded if leased land farming were eliminated.

Response: Field hunting opportunities for waterfowl on Tule Lake NWR would likely be reduced from curtailing water to the farming program. During the water shut-off of 2001, fewer fields than normal were suitable for field feeding geese, thus hunting opportunities were reduced.

Comment 58: Hunting harvest should be reported in the EA.

Response: Of the 5 Refuges in the Complex with waterfowl hunting programs, waterfowl hunters on Tule Lake and Lower Klamath NWRs traditionally harvest the greatest number of birds. In 1999 (a fairly typical year), 9,417 hunters on Lower Klamath NWR harvested 24,750

ducks and 939 geese and on Tule Lake, 5,201 hunters harvested 6,928 ducks and 1,985 geese. Fall water shortages to Refuge wetlands in 2000 and 2001 reduced combined waterfowl hunter numbers by 27% and 42%, respectively. Waterfowl harvest was reduced by a similar proportion.

Comment 59: The EA should show payments to counties as a percentage of discretionary dollars.

Response: This would be another way of portraying impacts to Counties from reduced lease revenues.

Comment 60: The economic value of waterfowl to the Pacific Flyway states should be reported in the EA.

Response: The Service is currently unaware of a source of information to make this estimate. Undoubtably, the economic value of waterfowl within the multiple state Pacific Flyway is greater than economic values within the Basin.

Comment 61: The value of Bald Eagle Conference should be reported in the EA.

Response: In recent years, the Bald Eagle Conference has attracted between 250 and 300 persons from throughout the Pacific Northwest. Persons attending the conference stay in local hotels and eat in local restaurants. The Service, however, is unaware of any precise estimates of the value of this event, in dollars, to the local economy.

Comment 62: What is the loss of wildlife economics that has occurred since passage of the Kuchel Act?

Response: The Service is currently unaware of a source of information to make this estimate.

Comment 63: Farming has negative effects on the visitor experience.

Response: In 2001, 199,000 and 177,000 visitors used Lower Klamath and Tule Lake NWRs, respectively. Over 90% of these visits were by non-consumptive users which were largely incidental visitors, essentially stopping on Hill Road (Tule Lake NWR) or Stateline Hwy (Lower Klamath NWR) for a quick view of wildlife while in transit to other locations. Traditionally, most non-consumptive visitors that tour National Wildlife Refuges come to view wildlife in "natural" surroundings. For these visitors, the large acreage of agricultural habitats, particularly on Tule Lake NWR may detract from their experience on this Refuge. In contrast, waterfowl hunters (consumptive users) traditionally hunt waterfowl species that are attracted to agricultural crops such as mallards, pintails, and white-fronted geese, thus, their experience is not usually negatively affected by agricultural lands. Other descriptions of recreational impacts are found in Sections 4.1.5, 4.2.5, and 4.3.5 of the draft EA.

Comment 64: Excessive Refuge staff time is devoted to leased lands. Staff time could be better spent in other activities.

Response: The Kuchel Act is unique relative to other legislation guiding management of National Wildlife Refuges within the System. Under the National Wildlife Refuge Administration Act of 1966 as amended, the Service has administrative control over Kuchel Act lands. Implementation of this Act for the Service is nondiscretionary, and at times, can consume a significant amount of staff time.

Comment 65: Local farmers have too much influence over Refuge decisions.

Response: The Service always attempts to be balanced in its dealings with the multitude of interest groups involved in Refuge operations.

Comment 66: There is no need for annual review of the farming program.

Response: The Service feels that annual review of the farming program is required so that farming operations that are detrimental to wildlife do not become entrenched within the leased lands. This process is also a way maintaining open communication with farmers which ultimately results in a more efficient program.

Comment 67: Reclamation has decision power for the leased lands.

Response: Under the National Wildlife Refuge Administration Act of 1966, as amended, the Service has the ultimate administrative control over all National Wildlife Refuges including Kuchel Act lands. Reclamation administers the leased land program for the Service under a 1977 Cooperative Agreement.

Comment 68: The April 1 decision date is too late in the year to effectively administer the leased land program.

Response: This is an extremely late date and undoubtably would cause hardship to local farmers. The intent of Alternative 2 and 3 within the draft EA, however, was to receive as accurate a water supply forecast as possible to potentially benefit Refuge wetlands. In wetter years under Alternative 2 and 3, decisions to lease farm lands could be made as early as February 10th.

Comment 69: The Service must work with Reclamation to stop illegal use of water in the Project as this may conflict with Refuge water needs.

Response: Although this is a legitimate concern, it is outside the scope of the draft EA.

Comment 70: Service should use its enforcement branch to stop agricultural activities that are illegal under ESA.

Response: Any potential violations of the ESA would be reported to our law enforcement branch.

LIST OF DRAFT ENVIRONMENTAL ASSESSMENT COMMENTORS

Organizations/Agencies:

A Hunter's Voice
American Lands Alliance
Audubon Society of Corvallis
Audubon Society of Portland
Audubon Society of Salem
Headwaters
Kettle Range Conservation Group
Klamath Siskiyou Wildlands Center
Modoc County Board of Supervisors
National Wildlife Refuge Association
Northwest Environmental Defense Center
Oregon Natural Resource Council - on behalf of the following organizations:
- Butte Environmental Council
- Cape Arago Audubon Society
- Cascadia forest Alliance
- Conservation Committee
- Constitutional Law Foundation
- Friends of Del Norte
- Juniper Group Sierra Club
- Kalmiopsis Audubon
- Klamath Forest Alliance
- Mazamas
- North Group
- Northcoast Environmental Center
- Oregon Natural Desert Association
- Oregon Watersheds
- Pesticide Action Network
- Pesticide Watch
- Redwood Chapter Sierra Club
- Rogue group Sierra Club
- Save the West, Inc,.
- Siskiyou Regional Education Project
- Soda Mountain Wilderness Council
- Umpqua Watersheds, Inc.

Sierra Club, Oregon Chapter
Siskiyou County Board of Supervisors
Siskiyou County Farm Bureau
Tule Lake Irrigation District
University of California, Intermountain Research and Extension Center
U.S. Bureau of Reclamation

J&W Walker Farms, Inc.
Water Watch (on behalf of Klamath Forest Alliance)
The Wilderness Society
Wildlife Management Institute

Individuals:

Mary Allardt-Wong
Janet Allen
Susan Applegate
Barbara Ballou
Pat Clancy
Jan Conley
Tammie Cramey
Susan Delles
Linda Das
Vicki Dern
Francis Eatherington
Alice Elshoff
Myra and Alan Erwin
Arthur M. Farley
Erik Fernandez
William W. and Juanita A. Forester
Teresa Giacomini
Kevin Gorman
Doug Heiken
Charlotte Horning
F. Ingram
David A. Inholt
John Koenig
David Krizo
Lyn Larson
Walter Lindley
Jim Low
Erin Madden
Judith L. McClure
Kathryn McKenzie
Simone McKenzie
Mark MacDonald
Brandt Mannchen
Chuck Mitchell
Susan Nutley
Frances Petschek
John and Sandra Potter
Jen Punzel
Peggy Risch
Bill Sefler
Rosie Seymour
Terence M. Shumaker
Leeanne Siart
Karen Sjogren
Mort Smith
Richard Spotts
Thomas Stanley
Josh Strange
Mary Ellen Sweeney
John Taylor
Merle and Marjorie Turner
Joanne Vinton
Sigmid G. Weidenweber

Sally Wells
Dee White
Michael T. Williams
Nancy Zierenberg

DRAFT
ENVIRONMENTAL ASSESSMENT

Implementation of the Agricultural Program on Tule Lake National Wildlife Refuge

Klamath Basin National Wildlife Refuge Complex

In Accordance with:

National Environmental Policy Act (1969)
Kuchel Act (1964)
National Wildlife Refuge System Administration Act of 1966, as amended

January 19, 2001

Implementation of an Agricultural Program on
Tule Lake National Wildlife Refuge

EXECUTIVE SUMMARY

The U.S. Fish and Wildlife Service (Service) is the responsible agency for administering the 500+ unit National Wildlife Refuge System. The mission of the refuge system is "... to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Improvement Act of 1997).

The National Wildlife Refuge Administration Act of 1966 and the recently enacted Refuge Improvement Act of 1997 mandate that all secondary uses on National Wildlife Refuges must be compatible with the primary purposes for which the refuge was established and the mission of the National Wildlife Refuge System. In addition, the Kuchel Act of 1964 mandates that commercial agriculture on Tule Lake and Lower Klamath National Wildlife Refuges (NWRs) be consistent with the primary purpose of waterfowl management.

The Klamath Basin NWR Complex prepared a Compatibility Determination (CD) in 1994 which determined that farming on the Refuges was compatible and consistent, with stipulations, with the primary purposes for which Tule Lake and Lower Klamath NWR were established. The 1994 CD has been re-certified annually through 1998. However, the 1994 CD did not consider impacts of water shortages to Refuge wetlands. Water planning in 1997-98 as part of the Bureau of Reclamation's 1998 Klamath Project Operations Plan and more recent analysis by Service hydrologists indicate that water shortages to Refuge wetlands could be expected in a large proportion of future years. Potential impacts to biological resources on Tule Lake and Lower Klamath NWRs are significant. This has necessitated a re-evaluation of current water use on the Refuge and development of a new CD in 1999 which specifically addresses water use by the Refuge's agricultural program.

This document describes the habitats, biological resources, and water needs on Lower Klamath and Tule Lake NWRs in relation to recent changes in water planning within the Klamath Reclamation Project. Presently, under conditions specified in the Kuchel Act, the Service administers, in cooperation with the Bureau of Reclamation (Reclamation), a 20,410 acre commercial lease agricultural program on Tule Lake and Lower Klamath NWRs. In addition, a cooperative farming program comprised of approximately 5,132 acres is administered by the Service. These programs are significant water users. In some years, where water supplies are insufficient to meet all Refuge needs including leased agricultural lands, especially during the April to October period, the agricultural program may use water that could otherwise be available for waterfowl management and other wetland needs on the Refuge.

To implement the farming program in a manner that does not threaten water supplies for Refuge wetlands, the Service has prepared a Draft Environmental Assessment (EA) which explores Alternatives for implementing the current farming program under the water stipulations in the 1999

CD. As part of internal scoping, public comments received on the Draft Discussion Paper issued March 15, 1999, and discussion with Tule Lake Irrigation District, the Service identified several issues associated with the farming program, including impacts to Refuge biological resources, socioeconomics, noxious weeds, soil erosion, recreation, agricultural foods for waterfowl, and public controversy. Three Alternatives were developed; Alternative 1 (No Action) (historic farming prior to 1999 CD), Alternative 2 (decision based on inflow criteria from the February 1st and/or April 1 NRCS forecast with mid-season irrigation curtailment possible), and Alternative 3 (preferred) (decision based on inflow criteria from the February 1 and April 1st NRCS forecast without the potential for mid-season irrigation curtailment). Impacts of alternatives relative to identified issues are discussed.

CHAPTER 1: INTRODUCTION, PURPOSE AND NEED, LEGAL FRAMEWORK, AND HYDROLOGIC ANALYSIS FOR IMPLEMENTING THE 1999 COMPATIBILITY DETERMINATION ON TULE LAKE AND LOWER KLAMATH NATIONAL WILDLIFE REFUGES

1.0 INTRODUCTION

The Klamath Project (Project) was authorized by the Secretary of the Interior in 1905 for the reclamation of certain lands in the Upper Klamath Basin. Also in 1905 and in support of the Project, the States of California and Oregon ceded certain lands to the United States including those under Lower Klamath and Tule Lakes. As part of the Project, Link River and Clear Lake dams, Lost River diversion, and a host of other dams, canals, and drains were constructed.

In the midst of reclamation, Lower Klamath and Tule Lake National Wildlife Refuges (NWRs) were created via Executive Orders in 1908 and 1928, respectively. Although these Orders provided for the conservation of wildlife on these areas, the lands also remained subject to reclamation uses. After decades of debate, the future of these Refuges was finally settled with passage of the Kuchel Act in 1964. The Act dedicated the lands to wildlife conservation for the primary purpose of waterfowl management, but with full consideration to optimum agricultural use that is consistent with waterfowl management; the Act permanently placed the lands in governmental ownership. Although, the Kuchel Act allows agricultural use of the Refuges, farming is secondary to waterfowl management purposes.

Historically, wetlands on both Refuges were beneficiaries of the Project system by receiving natural flows, water diverted from Project facilities, and agricultural return flows. In the late 1980's and the 1990's, the listing of the shortnose and Lost River suckers in Upper Klamath Lake and the listing of coho salmon in the Klamath River, development of new scientific information, and heightened awareness of tribal trust obligations in the Klamath River and Upper Klamath Lake required that the Department of the Interior review Project operations. To this end, Interior Regional Solicitors issued legal opinions on July 25, 1995 and January 8, 1997, which recognized senior water rights of Klamath Basin Tribes and requirements under the Endangered Species Act (ESA). Refuges were recognized to be entitled to federal reserved rights, junior in priority, and to a portion of the 1905 Project right.[1] The potential for reduced delivery to agriculture reduced the probability that adequate water supplies would be available to the Refuges in all years.

On April 1 of each year, the Natural Resources Conservation Service (NRCS) issues a forecast of estimated inflows to Upper Klamath Lake for the April to September time period. Reclamation uses this forecast to predict the availability of water to Project irrigators and the Refuges after Upper Klamath Lake levels and Klamath River flows have been met. In Reclamation models (KPOPSIM), water is not delivered to Lower Klamath NWR via the ADY Canal or to Tule Lake NWR's managed

[1] The Service filed claims in the Klamath Basin Adjudication for federal reserved rights as well as vested water rights for water received through the Klamath Project. The State of Oregon has initially recognized the claims in its preliminary report issued October 4, 1999.

wetlands until after agricultural water needs are set. If water is insufficient to meet agricultural needs, traditional water supplies via "D" Pumping Plant are expected to be insufficient to meet water needs on Lower Klamath NWR (as experienced in 1992 and 1994).

The Service obtained copies of KPOPSIM from Reclamation and estimated delivery of water by time periods (April-August, September-October) to seasonal and permanent wetlands on Lower Klamath NWR using river flows and lake levels identified in Reclamation's 1998 Klamath Project Operations Plan (U.S. Bureau of Reclamation 1998). Based on this analysis, it was determined that a significant acreage of wetland habitat may be dry in about half of future years (U.S. Fish and Wildlife Service 1999). Similar impacts to a portion of Tule Lake NWR wetlands would be anticipated (U.S. Fish and Wildlife Service 1999). The recent listing of coho salmon in the Klamath River in 1997 and additional information on water needs for this species have resulted in additional water dedicated to Klamath River flows (See Reclamation's 2000 water plan). These additional river flows may further reduce water supplies to wetlands on Lower Klamath and Tule Lake NWR (Tables 1.1 and 1.2). Under Upper Klamath Lake levels and Klamath River flows identified in Reclamation's 1998 and 1999 water plans, impacts to refuge wetlands are significant in water years with less than average inflows to Upper Klamath Lake.

The level of impacts to wetlands on Lower Klamath NWR, in particular, threatens the ecological integrity of the Refuge and necessitates a re-evaluation of how water is presently used within the farming program on both Tule Lake and Lower Klamath NWRs. Unless more storage or other water development occurs in the Basin, it is unlikely that Reclamation will have more water within the Project than is currently available.

It is paramount that Refuge wetlands receive as full a supply of water as possible for several reasons: first and foremost, to meet Refuge purposes for wildlife conservation; second, to replace wildlife values lost to the Basin and Pacific Flyway with the 80% reduction in the Basin's historic wetland habitats; and third, to offset the further loss of wetland habitat in the Basin that occurs during dry (186,000-312,000 acre-feet inflow to Upper Klamath Lake, Apr-Sep) and below average water years (313,000-500,000 acre-feet inflow to Upper Klamath Lake, Apr-Sep). The current acreage of wetlands in the Basin is insufficient to achieve the goals in the North American Waterfowl Management Plan of which the United States, Canada, and Mexico are signatories (U.S. Fish and Wildlife Service 1989).

The Service is the responsible agency for administering the 500+ unit National Wildlife Refuge System. The mission of the Refuge System is "... to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Improvement Act of 1997). In addition to the Refuge System, the FWS is responsible for implementation of the Endangered Species Act and for conservation of the migratory bird resource. Tule Lake and Lower Klamath NWRs are key migrational staging areas within the Klamath Basin and the Pacific Flyway and provide habitat for four species listed under the ESA.

The National Wildlife Refuge Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, mandates that all uses on National Wildlife Refuges must be compatible with the purposes for which the Refuge was established and the mission of the National Wildlife Refuge System. In addition, the Kuchel Act of 1964 mandates that agriculture on Tule Lake and Lower Klamath National Wildlife Refuges (NWRs) be consistent with the primary purpose of waterfowl management. For the purpose of the compatibility determination process, the "consistent therewith" requirement in the Kuchel Act is deemed synonymous with the "compatibility" requirement in the Refuge Administration Act and the Refuge Improvement Act.

1.1 PURPOSE AND NEED FOR ACTION

The purpose of this EA is to assess alternatives for implementation of the agricultural program on Tule Lake NWR based on the 1999 CD, relative to stipulations regarding water availability.

The potential for impacts to waterfowl and other wildlife associated with reduced water supplies (Tables 1.1 and 1.2) necessitated a re-evaluation of the Refuge's agricultural program (lease lands and cooperative farming) relative to its consumption of water in years of insufficient supply. To this end, a new Compatibility Determination (CD) was completed in February of 1999, which replaced the CD prepared in 1994. The 1999 CD concludes that the agricultural program on Tule Lake and Lower Klamath NWRs is compatible and consistent with the primary purposes for which these two Refuges were established, and the mission of the Refuge System, only if sufficient water is available to maintain Refuge wetlands first, followed secondarily by water for use on agricultural crops.

A full complement of seasonal and permanent wetlands on Tule Lake and Lower Klamath NWRs is required to meet Refuge and Refuge System purposes. Other measures to ensure compatibility include implementation of an Integrated Pest Management Plan (IPM), continued application of the Pesticide Use Proposal (PUP) process, evaluation of the "Integrated Land Management" concept, weed control and cover establishment, fall work, and burning on agricultural lands. These measures do not change materially from the 1994 CD. An IPM plan and associated NEPA document to address these measures was recently completed.

During the irrigation season (April - September) the farming program on Tule Lake (Figure 1.1) receives most of its water via return flows from "upstream" irrigation districts as well as Tule Lake Irrigation District (TID) itself. As such, the farming program on Tule Lake NWR may be "intercepting" return flows that would be needed on Refuge wetlands in years of insufficient water supply. The farming program on Lower Klamath NWR predominately irrigates during the winter when water supplies normally are not limited. Summer irrigation water for this program is drawn directly from the Klamath River rather than from return flows.

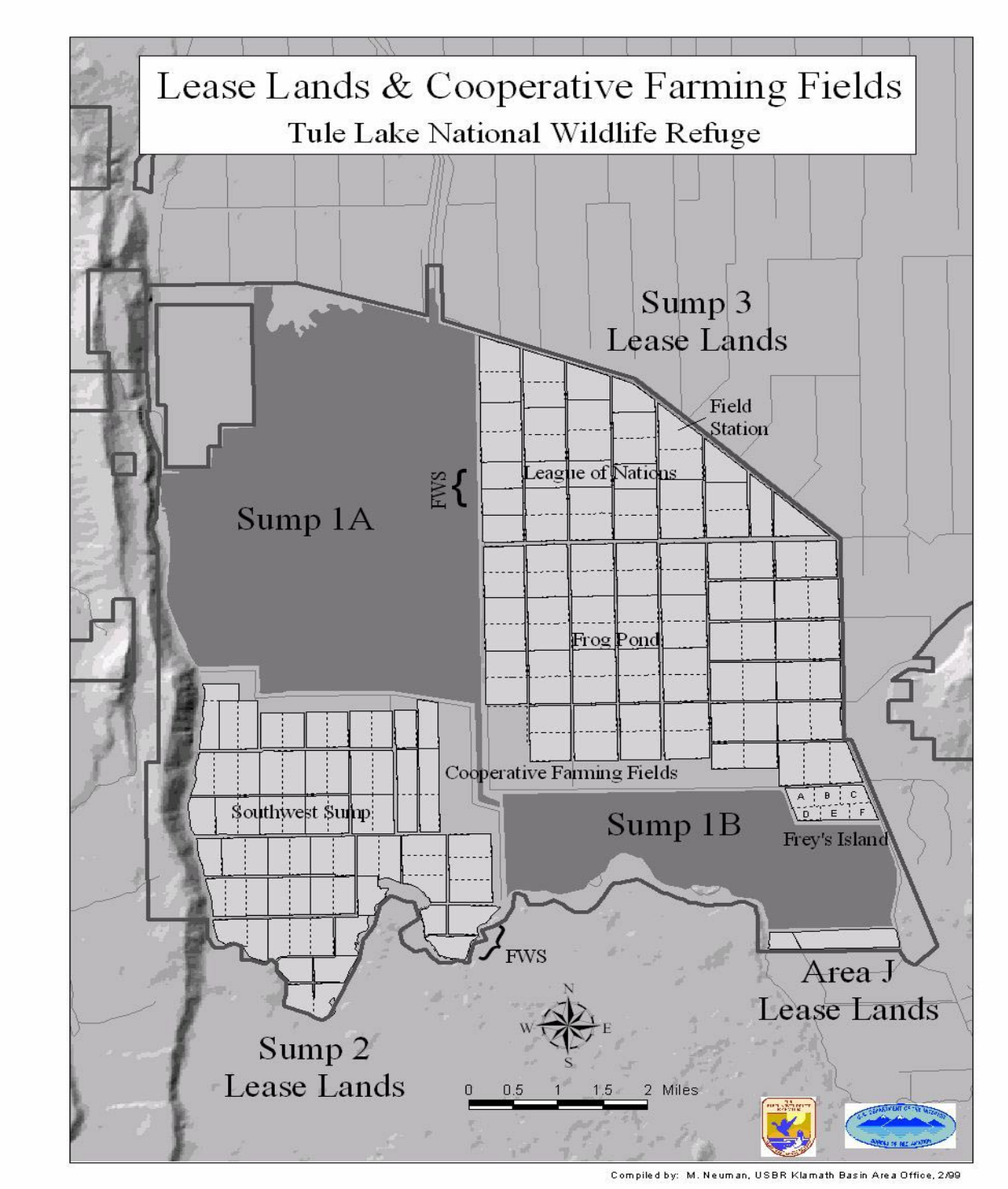

Figure 1.1 Tule Lake National Wildlife Refuge, California

1.1.1 Issues

On March 15, 1999, the Service distributed to the public a "Draft Discussion Paper" which outlined the issue of water shortages to Refuge wetlands related to water consumption by the Refuge's agricultural program. In the "Draft Discussion Paper" the Service described two potential options. Option 1 based the decision to lease agricultural lands on the April 1st NRCS forecast at the 50% exceedance level and Option 2 based the decision to lease on the February 1st NRCS forecast at the 70% exceedance level.

As part of the Draft Discussion Paper, the Service requested comments and additional information from the public. A total of 88 pieces of correspondence were received. Of these, 80 individuals supported Option 2 (use of the February 1st NRCS forecast to evaluate the potential for leasing) in the Draft Discussion paper and voiced their support for the concept of wildlife receiving first priority for water on the Refuge. One individual opposed Option 2. Three individuals voiced concerns about Refuge practices that were unrelated to the water issue. Three interest groups expressed support for Option 2. One group expressed concerns over an unrelated Refuge program. To the maximum extent possible, all pertinent concerns were incorporated into this Draft Environmental Assessment (EA).

Shortly after release of the Draft Discussion Paper, Tule Lake Irrigation District (TID) filed a lawsuit against the Service over the addition of the "water language[2]" to the 1999 leases. Shortly, thereafter the Service and TID entered into a stipulation which resulted in dismissal of the lawsuit without prejudice. The Service, in the stipulation, agreed to reconsider the "water language" in future years after reviewing information provided by TID and public comments received on the Draft EA. Refuge staff met with TID and their consultants on March 4, April 13, May 11, August 8 and September 27, 1999 to discuss the water issue, share information, and clarify positions. In addition, a tour of TID lands and Lower Klamath NWR was conducted on May 12, 1999.

As a result of this process, the Service provided TID information (letter dated May 3, 1999) pertaining to Lower Klamath NWR water demands, Refuge demands for specific water years, and copies of KPOPSIM model runs used in the Service's hydrologic analysis. TID provided to the Service their analysis of water use by the lease lands (memo dated July 29 and August 17, 1999), comments on the Service's return flow analysis (memo dated August 17, 1999), and a description of their operations if the farming program on Tule Lake NWR were curtailed (draft memo, November 10, 1999) The Service responded to TID's August and July memorandums with comments via a letter dated September 13, 1999.

TID provided comments to the Service on the Draft Discussion Paper on April 20, 1999. TID's primary concerns were the disruption of local economies, loss of revenues to TID and local governments, loss of wildlife habitat, depredation of crops, noxious weeds, and concerns over the

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[2] The "water language" states: In the event there is an insufficient supply of water available, irrespective of cause, to the Lower Klamath and/or Tule Lake National Wildlife Refuges, based on notification by the Area Manager [Reclamation], the lessee may be required to forego application of irrigation water to the leased premises that is obtained through Klamath Project facilities as directed by the Refuge Manager in accordance with the current Compatibility/Consistency Determination and related documents.

legal authority to effect the action. To the maximum extent possible TID's comments have been incorporated into this Draft EA.

As a result of comments received from the public regarding agricultural foods for waterfowl, the Service contracted with Dr. Robert Frederick from the Eastern Kentucky University to update his computer model for fall staging white-fronted geese on Tule Lake NWR. Dr. Frederick modified his model to incorporate all field feeding waterfowl species and used the model to predict impacts that might occur if modifications were made to the Tule Lake NWR farming program. To this end, the Service provided a list of potential farming scenarios. A summary of Dr. Frederick's findings and a list of farming scenarios provided by the Service can be found in Appendix 2.

After considering public comments on the Draft Discussion Paper, and discussions with TID, the Service identified the following issues:

1. Impacts to Refuge biological resources
2. Socioeconomic impacts
3. Noxious weeds and water consumption
4. Soil erosion
5. Recreation
6. Food resources for waterfowl and depredation
7. Public controversy

1.1.2 Decision by Responsible Official

Based on information and analysis in this Draft EA, comments received on the Draft EA, and comments received on the Draft Discussion Paper (released March 1999), the Refuge Manager will select an alternative to implement the water stipulations within the 1999 CD for the agricultural program on Tule Lake NWR.

1.2 LEGAL FRAMEWORK

Lower Klamath NWR was established on August 8, 1908, by Executive Order 924 which reserved and set aside the area "as a preserve and breeding ground for native birds." The Executive Order further provided that it "is made subject to and is not intended to interfere with the use of any part of the reserved area by the Reclamation Service acting under the provisions of the act approved June 17, 1902, or any subsequent legislation." Several subsequent Executive Orders modified the boundaries of Lower Klamath NWR. *See* Executive Order 2200 (May 14, 1915); Executive Order 3187 (December 2, 1919); Executive Order 3422 (March 28, 1921); and Executive Order 8475 (July 10, 1940).

The Tule Lake NWR was established on October 4, 1928, by Executive Order 4975. The Executive Order "reserved and set apart . . . [the area] as a Refuge and breeding ground for birds." The Executive Order further provided that the reservation "is subject to the use thereof by said Department [of the Interior] for irrigation and other incidental purposes, and to any other valid existing rights."

Tule Lake NWR was enlarged to 11,000 acres on November 3, 1932 by Executive Order 5945, and on April 10, 1936 the Refuge was enlarged to its present size of about 39,000 acres by Executive Order 7341.

In 1942, the Service and Reclamation executed an agreement providing for the Service to directly manage certain lands within the executive boundaries of the Refuges primarily for Refuge purposes, but consistent with the needs of the Klamath Project. This agreement responded to concerns that the Service did not have the authority to manage these lands for wildlife (and waterfowl) purposes because they were subject to reclamation uses. This agreement paved the way for a permanent arrangement sanctioned by Congress with the passing of the Act of September 2, 1964, Pub. L. 88-567 known as the Kuchel Act.

The Kuchel Act permanently dedicated the Refuge lands to wildlife conservation. In addition, the Act provided that the major purpose of the Refuges was waterfowl management and provided for the continuation of the lease land farming program on the Refuges, provided that program is "consistent with" the major purpose of the Refuges which was waterfowl management. The Kuchel Act specified the areas in which such leasing program was to occur and placed certain limits on this program, in addition to the overall requirement that it be consistent with waterfowl management.

The National Wildlife Refuge System Administration Act (Administration Act) permits the Service to allow the use of Refuge areas for secondary compatible uses, provided that such use was determined to be compatible with the "major" purposes of the Refuge (Pub. L. 94-223, 16 U.S.C. section 668dd(d)(1)(A)). The National Wildlife Refuge System Improvement Act of 1997 (Improvement Act), Pub. L. 105-57, codified the definition of "compatibility" adopted by the Service under the Administration Act, but added a requirement that the use must be compatible with the mission of the Refuge system as well as the purposes of the Refuge. The Service has determined that the term "consistent therewith" in the Kuchel Act has the same meaning as "compatible" under the Administration Act and the Improvement Act. The Service reads the statutes as being consistent rather than in conflict.

The Administration Act was amended in 1976 to provide that the Service is to have primary administrative control over all lands within the National Wildlife Refuge System (Pub. L. 89-669, 16 U.S.C. section 668dd(a)(1)). The "Kuchel Act lands" are part of this Refuge system.[3] Thus, any question that remained since the passage of the Kuchel Act about whether the Service or Reclamation had the ultimate administrative control over the Refuge lands was settled. The Service and Reclamation entered into a new agreement for management of the Refuge lease land farming program in 1977 under which Reclamation manages the program with the Service retaining the ultimate administrative control.

The Service has taken the position in recent litigation in Federal District Court that the Refuge lease

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[3]The "Kuchel Act lands" include the following Refuges: Upper Klamath Lake including Hanks Marsh, Clear Lake, Lower Klamath Lake and Tule Lake. Only Lower Klamath Lake and Tule Lake NWRs have lands leased for farming.

land farming program is a "secondary purpose" of the Refuge, subject to the major or primary purposes of waterfowl management and wildlife conservation. In that litigation, the Court declined to address the issue as to whether the farming program was a "secondary purpose" or "secondary use" of the Refuge.[4] The Service completed determinations for the lease land farming program under the guidance developed for the compatibility determination process of the Administration Act.

1.3 HYDROLOGIC ANALYSIS

1.3.1 Estimated Shortages to Refuge Wetlands

Analyses of refuge shortages were conducted using Reclamation's KPOPSIM model, a water budget model for the Klamath Project. KPOPSIM allocates water among 17 time steps in the following priority: Upper Klamath Lake (UKL) levels first, followed by Klamath River flows, then agriculture and refuges. Allocations in the model can be changed but priorities can not, although a change in priority can be partially simulated by changing allocations to senior users. To evaluate refuge shortages, KPOPSIM was modified from its original version to reflect an increased refuge demand from the Ady Canal that is likely in future years if return flows become unreliable. Only refuge water demands during the April-October period were simulated. While the refuge has water needs outside of the April-October period, water supplies are generally not limited during that time.

Future requirements for lake levels and river flows are still being determined and will probably not be available until Reclamation completes its long-term Operations Plan for the Klamath Project. However, without significant augmentation of the available water supply, it is certain that there will be less water available for lower priority users (agriculture and refuges) in the future. An example of projected shortages to refuges under a given set of lake and river requirements is shown below (Table 1.1 and 1.2). This simulation used the lake levels and river flows from the 1999 Klamath Project Operations Plan. The operations plan was for an "above average" hydrologic year type. Future lake levels and river flow requirements may be lower in "below average" or "dry" year types. River flow requirements were slightly lower in 2000, a year which just made it into the "above average" hydrologic year type. If lake levels or river flows are lower, then more water would be available for the Project and refuge shortages may be diminished. Conversely, if lake levels or river flows are increased, then less water would be available for the Project and refuge shortages may be greater. The purpose of the modeling is to demonstrate the magnitude of impacts to the refuge that may be expected in the future. The modeling also assumed that refuges were junior in priority to all agricultural users. As such, the model simulation represents a worst-case scenario for the refuges, both in terms of priority and supply.

Lower Klamath NWR is the more severely impacted refuge because of the larger area of managed wetlands. Shortages to Lower Klamath are compounded because of the refuge's dependence on agricultural return flows through D plant pumping as well as UKL water. D plant has traditionally

[4] In that litigation, the court ruled in favor of the United States finding that the Service's 1994 compatibility determination and its 1998 recertification that the lease land farming program was compatible (consistent) with Refuge purposes was not arbitrary and capricious or contrary to law.

supplied Lower Klamath NWR with most of its water needs, especially for fall floodup. However, this source, which is comprised largely of return flows, may supply reduced water quantities if the Project is shorted water or becomes more conservative in its use of water in the future. In 1992 and 1994, two water-short years in the 1961-1997 period of record for the Project, D plant output was considerably reduced.

The model distributes projected shortages to Lower Klamath NWR throughout the season. Severe shortages occur May 1st - July 15th, a period of limited supply due to competing demands of lake levels, river flows, and Project users. With full agricultural demand and the given lake level and river flow requirements, the refuge receives no Ady water from May 1st to Jul 15th in critical, dry, and below average years (49% of all years). Agriculture is shorted severely during this period as well. Ady water deliveries to the refuge are limited during the remaining months in these same year types. Estimated reductions in return flows resulting from agricultural shortages (D plant pumping) mean that seasonally flooded wetlands are projected to be shorted significantly as well.

Table 1.1. Estimated mean impacts by water year type to wetlands on Lower Klamath National Wildlife Refuge. Estimates were derived from KPOPSIM using Upper Klamath Lake levels and Klamath River flows identified in the 1999 Klamath Project Operations Plan (U.S. Bureau of Reclamation 1999). Estimated impacts assume that refuge water needs are behind all agricultural water users.

Year Type[1, 2]	Number of Years (%)	Impacts to Permanent Wetlands during late summer.		Impacts to Seasonal Wetlands (acres dry on November 1)		Total Wetlands Dry November 1st for Peak Fall Migration		Acre- Feet of Water to Eliminate water shortages.
		Acres Dry	% Dry	Acres Dry	% Dry	Total Acres Dry	% Dry	
Dry	5 (14%)	8,888	79%	7,345	70%	16,233	75%	49,348
Below Average	11 (31%)	7,313	65%	6,191	59%	13,504	62%	41,052
Above Average	19 (54%)	1,238	11%	1,574	15%	2,812	13%	8,548
TOTAL	35							

[1] Dry = 186,000 - 312,000 acre-foot net inflow to Upper Klamath Lake, Apr-Sep.
Below Average = 313,000 - 500,000 acre-foot net inflow to Upper Klamath Lake, Apr-Sep.
Above Average = greater than 501,000 acre-foot net inflow to Upper Klamath Lake, Apr-Sep.
[2] Critical water years (<186,000 acre-foot net inflow to Upper Klamath Lake, Apr-Sep) not included.

Table 1.2. Estimated mean impacts to experimental wetlands on Tule Lake National Wildlife Refuge. Estimates of water shortages to experimental wetlands were assumed to be similar to those depicted in Table 1.1. Water levels in Sumps 1(A) and 1(B) (13,000 acres) are protected via a 1992 Biological Opinion.

Year Type[1,2]	N	% of Years	Total Wetland Acres	Acres Dry on Nov. 1	Percent Dry
Dry	5	14%	640	390	70%
Below Avg	11	31%	640	192	59%
Above Avg	19	54%	640	26	15%
TOTAL	35				

[1] Critical = less than 185,000 acre-foot inflow to Upper Klamath Lake, Apr-Sep.
Dry = 186,000 - 312,000 acre-foot inflow to Upper Klamath Lake, Apr-Sep.
Below Average = 313,000 - 500,000 acre-foot inflow to Upper Klamath Lake, Apr-Sep.
Above Average = greater than 501,000 acre-foot inflow to Upper Klamath Lake, Apr-Sep.
[2] Critical water years (<186,000 acre-foot inflow to Upper Klamath Lake, Apr-Sep) not included.

1.3.2 Water Use by Crop Type

Consumptive water use by the refuge farming program (Tule Lake and Lower Klamath NWR) for the period 1989-1998 was estimated based on reference ET and crop coefficients from the University of California Intermountain Research and Extension Center in Tulelake, CA and crop type and acreage data from TID, Reclamation and the Service. The agricultural program for both refuges has a combined average consumptive use of 59,405 acre-feet per year (Table 1.3). Of that total, 37,469 acre-feet of that total consumptuve use occurs during the April-October irrigation season, predominantly on Tule Lake NWR. The remainder of water use occurs during winter pre-irrigation (Lower Klamath NWR) when water supplies are generally not limited within the Basin.

1.3.2.1 Tule Lake NWR - Most irrigation on Tule Lake NWR lease and cooperative farm lots occurs between April and October. Compared to lots on Lower Klamath NWR, fields are small and drainage systems are more extensive. Depending on spring soil moisture, lots are often pre-irrigated in April prior to planting, with additional irrigations during summer (sprinkler and flood irrigation). Alfalfa and pasture/hay are the largest consumers of water per acre (Table 1.3) on Tule Lake NWR, primarily because of a longer irrigation period. Total April-October consumptive use for the lease lands and cooperative farm lots on the Tule Lake NWR is 35,467 acre-feet based on average cropping patterns for 1989-1998 and a 90% efficiency factor.

1.3.2.2 Lower Klamath NWR- The Lower Klamath NWR lease lands (Area K) which are planted to small grains and cooperatively farmed lots are pre-irrigated during the late fall and winter. Because of the high water holding capacity of these soils, no subsequent irrigation is required to complete a crop. Pasture/hay leases are similarly pre-irrigated during winter but also receive 1-2 flood irrigations during summer. It was assumed that these summer irrigations use 1.0 acre-feet/acre. In 1998, there were 1,802 acres of pasture/hay leases so the April-October consumptive use of these lands would be 1,802 acre-feet.

1.3.3 April-October Irrigations on Refuge Farm Lands and Impacts to Water Supplies for Lower Klamath NWR

The impact on water supplies for refuge wetlands from curtailing or reducing the refuge farming program depends on the source of irrigation water for the farm lands, particularly the farm lands on the Tule Lake NWR. If the farming program is reduced or eliminated, the location and availability of any water "savings" will depend in large part on the source of irrigation water. There are two sources to be considered for irrigation of the farm lands on Tule Lake NWR: UKL and return flows. If the source of irrigation water is UKL, then any water not diverted in the event of a reduction or elimination of refuge farming would remain in the lake. The water "savings" would be distributed to all other users according to the priority system of the Project. All Project irrigators would benefit from the water savings and refuge wetlands would receive at most a portion of this water and would realize only minimal benefits. This is the kind of scenario that KPOPSIM models.

Table 1.3. Water use by crop on Tule Lake and Lower Klamath NWRs lease lands. Water use figures are the average 1989-98 crop consumptive use (based on consumptive use data from the University of California Intermountain Research and Extension Center and crop data from TID).

Crop	**Average Annual Water Use ac-ft/acre**	**Average Apr-Oct Water Use ac-ft/acre**	**Tule Lake NWR** Cooperative farm lots and lease lands (avg. acres)	**Tule Lake NWR Total Water Use** (Total ac-ft)	**Tule Lake NWR Apr-Oct Water Use** (Total ac-ft)	**Lower Klamath NWR** Cooperative farm lots and lease lands (acres (1998))	**Lower Klamath NWR Total Water Use** (Total ac-ft)	**Lower Klamath NWR Apr-Oct Water Use** (Total ac-ft)
Pasture/Hay	2.82	2.62				1802	5082	1802
Alfalfa	2.96	2.83	1014	3001	2870			
Onions	2.17	2.11	510	1107	1076			
Sugar Beets	2.33	2.27	542	1263	1230			
Potatoes	1.77	1.72	2577	4561	4432			
Small Grains	2.00	1.94	11501	23002	22312	7724	15448	0
Total			16144	32934	31920	9526	20530	1802
Total[1] assuming 90% efficiency				36594	35467		22811	2002

[1] Total water use on Tule Lake lease and cooperative lots and Area K pasture/hay, assuming a 90% efficiency factor for seepage and transport losses

On the other hand, if return flows are the source of irrigation water for the refuge farm lands, then any water not diverted would remain or be delivered to Tule Lake. Because the refuge wetlands and refuge farm lands are the two major users of water in Tule Lake, refuge wetlands would be the major beneficiary of any water "savings" ending up in Tule Lake. This scenario can not be represented by KPOPSIM, which does not simulate the internal workings of the Project. To determine the source of irrigation water for the Tule Lake farm lands and quantify potential benefits to the refuge, Service hydrologists examined diversion data and developed a water budget of the two farm areas on Tule Lake NWR (Appendix 1).

Analysis of the water budget data indicates that return flow makes up most, if not all, of the irrigation water reaching the farm lands on Tule Lake NWR (see Appendix 1). This is the scenario that is most beneficial to the refuge. Return flows from other irrigated lands upgradient of the lease lands comprised an estimated 90% of the water supply for Sumps 2 and 3 (the Tule Lake NWR farm lands). If this return flow is not used to irrigate the lease lands, it remains in or is delivered to the Tule Lake sumps, either directly through the N canal or through return flow pumps capturing subsurface seepage in Sumps 2 and 3. This water would ultimately be pumped through D plant to Lower Klamath NWR. **The Service assumes that there are no limitations to using the water "savings" on Tule Lake and Lower Klamath NWRs.**

April-October consumptive use of the Tule Lake NWR crops for the 1989-1998 period of record is 35,467 acre-feet (2.09 acre-feet/acre), assuming a 90% efficiency rate. Not all of the crop evapo-transpiration (ET) in the lease lands is met with applied irrigation. Some of the crop ET is supported by precipitation and soil moisture, although this fraction is smaller in dry years. The average annual precipitation at Tulelake is 10.91" or 15,500 acre-feet for the 17,000 acres of refuge farm lands (Western Regional Climate Center). "Effective precipitation" defines the proportion of precipitation available for crop consumptive use and not lost to runoff, evaporation, or deep percolation. A recent study by the BOR estimated that effective precipitation in the Klamath Basin was 41% (Davids Engineering, 1998). Using this value, approximately 6,340 acre-feet of water would be available from precipitation for crop consumptive use in an average year. Since this is not applied water that would be delivered to the Tule Lake sumps if it were not used, it must be removed from the potential water "savings." Therefore, estimates of the volume of applied irrigation utilized by the Tule Lake farm program range from 29,000 to 35,500 acre-feet. The low number assumes an average contribution to crop ET from precipitation while the high number assumes no contribution to crop ET from precipitation.

The Lower Klamath NWR lease lands are assumed to be irrigated with direct diversions from UKL through the Ady and Central canals. Therefore, water "savings" resulting from curtailment of the Lower Klamath lease land program would be shared by all other Project users and refuge benefits would be minimal. The fact that these lands are directly irrigated from UKL and that these lands receive a major portion of their water in the winter means that there would be little benefit to the refuge water supply from curtailing the farm program here.

Measurements of surface diversions to laterals and farm turnouts in the Tule Lake NWR farm lands appear to balance estimated crop consumptive use (Appendix 1). In Sump 3, surface diversions

average 25,308 ac-ft and crop consumptive use is estimated at 21,141 ac-ft annually. In Sump 2, surface diversions average 18,122 ac-ft and crop consumptive use is estimated at 12,198 ac-ft annually. Total surface diversion for the two areas average 43,430 ac-ft, about 10,000 ac-ft more than the estimated ET demand of the crops. Irrigation efficiency, defined as crop ET/total diversions is 77%, lower than the value assumed in the analysis above. Based on these numbers, the diversions to these two areas exceed crop ET demand by about 30%. Crop consumptive use numbers and assumed water "savings" appear reasonable considering irrigation inefficiencies.

Implicit in this estimate is the assumption that return flow from the rest of TID and other private lands would continue to be generated at the same rate even with a reduction or curtailment of the refuge farming program on Tule Lake NWR. TID has said that while they do not explicitly divert additional water from Station 48 for the lease lands, the system is operated with the knowledge that excess water or return flows will be used on the lease lands. TID expects that there would be some management changes without a refuge farming program. Early season deliveries to the lease lands (estimated at 5,000 ac-ft for March-April) would not occur. Station 48 May-September deliveries are expected to be decreased by about 5,000 ac-ft (< 5% of the average total deliveries reaching TID for the same period). To the extent that this water contributes to D Plant outflows, then these outflows would be reduced. The timing of outflow from D Plant may be affected as well.

Another issue of consideration is the consumptive use of plants that grow on the fallowed lands. Even in the absence of applied water, the farm lands will have weeds or cover crops growing on them. To the extent that groundwater seepage is intercepted by weeds, then return flow output from the drain pumps would be reduced. Final results from a fallow land ET study are not available yet. Preliminary results indicate that the consumptive use by weeds/cover crops on fallow lands was about 21,250 acre-feet (1.25 acre-feet/acre) but the proportion of this ET coming from stored soil moisture versus groundwater is not known. Groundwater levels were initially 2.5-3.0' below the soil surface and declined by at least another foot during the season. Available water for these soils is reported to be 0.3-0.5 inches/inch of soil (3.6-6.0"/ft of soil). Assuming an average of 0.4"/in of soil, there could have been 14.4" of stored water in the soil profile at the beginning of the season, assuming 3' of unsaturated soil and field capacity initially. Stored water could have accounted for most of the fallow ET. This is higher than the assumed volume of effective precipitation used by crops but weeds are more efficient at utilizing stored moisture than crops. Further analysis of the results from this study will address some of these issues.

The Service assumes that curtailing the farming program on Tule Lake NWR would free up a volume of water equal to the portion of crop consumptive use met through applied irrigation minus the portion of weed consumptive use met through interception of groundwater seepage. The estimate of water savings through curtailment of the Tule Lake farm program is based on assumptions about precipitation and fallow land ET. Assuming an average contribution of precipitation to crop ET, the volume of applied irrigation utilized by the crops is 29,000 acre-feet. Assuming that weed ET, estimated at 21,250 acre-feet, utilizes an equal contribution of precipitation, then the volume of groundwater intercepted and utilized by weeds is 15,000 acre-feet. Subtracting this from the estimate of applied irrigation meeting the crop consumptive use results in a water "savings" estimate of 14,000 acre-feet. If weed consumptive use uses more of the stored soil moisture, then a smaller volume of

groundwater interception is subtracted from the crop consumptive use and the estimated "savings" is greater. Assuming the weeds utilize all stored moisture and intercept no groundwater means that nothing is deducted from the volume of applied irrigation meeting the crop consumptive use and the estimated "savings" is 29,000 acre-feet. The estimated "savings" range from 14,000 to 29,000 acre-feet. The actual number is probably somewhere in between. In any case, a "savings" of this magnitude could provide a much needed supply of water to Lower Klamath NWR in below average and dry years (Table 1.1).

The timing of the available water will depend on the timing of return flows and on the operation of the Tule Lake sumps and the D plant pump. Return flows are generated throughout the irrigation season with a maximum in July and a minimum in October. There is an ESA-minimum elevation requirement on Tule Lake of 4034.6' from April 1st to Sept 30th and 4034.0 from Oct 1st to Mar 31st. Storage above the summer lake elevation of 4034.6' is limited. With limited storage in the sumps, return flows will presumably be routed through D plant as they are delivered to the Tule Lake sumps. Under the 1999 Klamath Project Operations Plan, for example, the projected shortages to Lower Klamath NWR are distributed throughout the season. Timing of available water is not of critical importance. Water is needed during the entire April-October period.

CHAPTER 2: ALTERNATIVES INCLUDING PROPOSED ACTION

2.0 INTRODUCTION

This chapter summarizes the Service's proposed action: Implementation of the farming program on Tule Lake NWR based on the water stipulations within the 1999 Compatibility Determination. No change is proposed in the Lower Klamath NWR farming program because hydrologic analysis indicates that benefits to the refuge would be the overall reduction in the demand on the system. A reasonable range of alternatives is described including Alternative 1 (No Action) (historic farming prior to 1999 CD), Alternative 2 (decision based on inflow criteria from the February 1st and/or April 1 NRCS forecast with mid-season irrigation curtailment possible), and Alternative 3 (preferred) (decision based on inflow criteria from the February 1 and/or April 1st NRCS forecast without the potential for mid-season irrigation curtailment). A summary of alternatives is presented in Table 2.1.

2.1 MEASURES COMMON TO ALL ALTERNATIVES

The following measures are necessary to ensure compatibility of the Refuge farming program. These items are part of all Alternatives considered in this EA and have been addressed in the IPM EA.

2.1.1 Integrated Pest Management Plan – In accordance with Interior and Service policy, an Integrated Pest Management Plan (IPM) and associated NEPA document have been prepared and the program implemented in 1999. In addition to meeting the mandates of Interior and Service policy, the IPM plan will balance pest control practices with the goals of agricultural production and profitability, consistent with wildlife management, as mandated by the Kuchel Act.

2.1.2 Pesticide Use Proposals – All pesticide use that occurs on the Tule Lake and Lower Klamath NWRs will conform to Interior's Pesticide Use Proposal Process. As part of the process, growers submit a list of products, concentrations, and application methods to the Service for approval. This list is reviewed by refuge managers, biologists, wildlife toxicologists, farm land managers, and IPM specialists. Products are reviewed based on toxicity, availability of less-toxic alternatives, and whether cultural or biological methods could be substituted.

2.1.3 Pesticide use and endangered species – All farming and pesticide applications occurring on Tule Lake and Lower Klamath NWRs will be consistent with the Biological Opinions dated February 9, 1995 and November 2, 1998. Conservation measures in these documents are intended to protect endangered and threatened species using the refuges.

2.1.4 Fall work – Burning, tillage, and irrigation in the fall will be subject to refuge approval to ensure that waterfowl habitat values of farm lands are not compromised. In addition, burning or tillage of farm lands will not be allowed until a determination is made as to available water for wetlands and farming. Fall tillage of small grains in particular has the potential to decrease the availability of waste grain for waterfowl. Burning and fall irrigation can affect use patterns of waterfowl, potentially increasing crowding and the subsequent potential for disease. These practices

also have the potential to affect refuge recreational opportunities. Compatible wildlife-dependent recreation was recently made a priority general public use of the Refuge System by the National Wildlife Refuge System Improvement Act of 1997.

2.1.5 Soil erosion -Burning or tillage of farm lands will not be allowed until a determination is made as to available water for wetlands and farming. Should insufficient water be available for farming, this stipulation will ensure that non-farmed fields will be protected from soil erosion and weed invasion. Fall cover crop plantings on row crop fields will be required to protect those lands from erosion in the winter as well as the subsequent growing season. In addition, small grain cover crops will provide foods for waterfowl in the subsequent growing season in the event of insufficient water.

2.1.6 Wildlife habitat on dikes and berms – Noxious weed control through the establishment of more desirable, competitive plants will remain an ongoing program within the farming program. Establishment of more wildlife-beneficial habitats will suppress weed populations as well as provide enhanced habitat for ground-nesting birds and winter cover for other wildlife species.

2.1.7 Annual review of the farming program – Annual review of farming practices to ensure techniques are compatible with waterfowl management is required. Crop types and varieties, irrigation and cultural practices as well as other agricultural activities are in a constant state of change. Annual review of the program will prevent the widespread adoption of practices that are incompatible with refuge purposes.

2.1.8 Area K (Lower Klamath NWR) - Most water needs on Area K for small grain farming are met via winter pre-irrigations when water is excess to that needed by other users in the Upper Klamath Basin. Pre-irrigation will occur after refuge wetland needs are met or as needed to meet refuge wildlife purposes. Once these lands are pre-irrigated, small grain farming will occur in the subsequent growing season independent of April - September Project water supply projections.

Spring/summer irrigations for pasture/hay leases are drawn directly from the Klamath River (from Upper Klamath Lake), therefore, the benefits to refuge wetlands of curtailing this program are minimal (See Section 1.3). As such, April-September irrigations in Area K pasture/hay lots are not subject to irrigation restrictions.

2.1.9 Cooperative Farming (Lower Klamath NWR) - Most water needs on cooperative farm fields on Lower Klamath NWR are met via winter irrigations when water is excess to other water users in the Upper Klamath Basin. These lands will be pre-irrigated after refuge wetland needs are met or as needed to meet refuge wildlife purposes. Once these lots are pre-irrigated, small grain farming will occur in the subsequent growing season independent of April - September water availability within the Project.

2.2 DESCRIPTION OF ALTERNATIVES

2.2.1 ALTERNATIVE 1 (NO ACTION): Historic Tule Lake NWR farming prior to 1999 CD.

This alternative assumes continuing the historic Tule Lake NWR farming program (as under the 1994 CD which includes all measures listed in Section 2.1 that do not relate to water availability).

Under this alternative, use of water by the Tule Lake NWR farming program is assumed to continue even in years in which sufficient water would not be available for wetland habitats. Implementation of this alternative could result in water being used in the Tule Lake farming program that otherwise could have been available for use in Refuge wetlands in dry and below average water years.

2.2.2 ALTERNATIVE 2: Farming consistent with 1999 CD - Potential for mid growing season irrigation curtailment.

This alternative relates to April to September irrigations in Tule Lake NWR cooperative farm lots and lease lands in dry, below average and above average water year types. In the event of a critically dry year, significant changes to Project operations are likely. If a critically dry year is likely, the Service will re-assess the potential impacts of the farming program on water supplies for refuge wetlands. This alternative assumes the water source is primarily return flows from irrigation "upgradient" of the lease lands.

Implementation of this alternative is intended to alleviate, as much as possible, water shortages to Refuge wetlands identified in Tables 1.1 and 1.2. This alternative would be implemented if Service hydrologists using KPOPSIM determine, based on Reclamation's annual or long-term Operations Plan, that water shortages to refuge wetlands are likely during the summer/fall period. The potential for wetland shortages will depend upon inflow to Upper Klamath Lake during the irrigation season in combination with Klamath River flows, Upper Klamath Lake levels, and water augmentation practices identified in Reclamation's annual or long-term Operations Plan. As a first decision point, the Service will use the Natural Resource Conservation Service's (NRCS) February 1st forecast at the 70% exceedance level as an estimate of inflows to Upper Klamath Lake during the irrigation season. This value will be input to KPOPSIM to determine if wetland shortages are likely in the coming summer/fall season. An initial decision to lease would be made on or about February 10th.

A decision not to allow Apr-Sep irrigations based on the February 1st NRCS forecast could be reversed if the April 1st forecast at the 50% exceedance level indicates that sufficient additional water supplies had accumulated during February and March to serve both Refuge agricultural programs as well as Refuge wetlands. The decision to lease based on the April 1st NRCS forecast would be made on or about April 10th. In the event of an above average snow pack, using the February 1st forecast will allow growers additional time to plan spring planting operations.

Of the 2 forecasts, the April 1st forecast is believed to be more accurate than earlier forecasts. At a 50% exceedance value, there is a 50% chance that the actual April-September inflow value for Upper

Klamath Lake will be greater than forecast value. The February 1st 70% exceedance value means there is a 70% chance that actual inflow value will be greater than the predicted value. Because of the relative lack of precision in the February forecast, the Service selected the 70% exceedance value to better ensure that adequate water would be available for Refuge wetlands. The Service believes that by curtailing the leasing program on Tule Lake NWR, return flows that otherwise would be consumed by agricultural crops will be available to refuge wetlands (see Section 1.3.3). **If the decision is made to proceed with farming on Tule Lake NWR under Alternative 2 (either in February or April) but unforseen circumstances reduce available water supplies resulting in insufficient water for Refuge wetlands, leases granted in February or April will be terminated and no leasing will occur, or irrigation during the growing season will be curtailed. The elimination of the agricultural leasing program for that year and/or curtailing of irrigation is intended to make return flows, otherwise used in the agricultural program, available to Refuge wetlands.**

2.2.3 ALTERNATIVE 3 (Preferred): Farming consistent with 1999 CD - No mid-season curtailment in agricultural irrigations.

This alternative relates to April to September irrigations in Tule Lake NWR cooperative farm lots and lease lands in dry, below average and above average water year types. In the event of a critically dry year, significant changes to Project operations are likely. If a critically dry year is likely, the Service will re-assess the potential impacts of the farming program on water supplies for refuge wetlands. This alternative assumes the water source is primarily return flows from irrigation "upgradient" of the lease lands.

Decision dates, methodology, and rationale for Alternative 3 are identical to Alternative 2 except that elimination of the leasing program or a mid-season irrigation shut-off would not be implemented under Alternative 3. **Thus, if the decision is made to proceed with farming on Tule Lake NWR under Alternative 3 (either in February or April), agricultural operations would proceed normally for the duration of the irrigation season.**

2.3 MEASURES TO LESSEN IMPACTS TO THE AGRICULTURAL PROGRAM

The following measures, alone or in combination, have the potential to alleviate some of the water shortage to refuge wetlands currently anticipated in below average and dry water-years. The degree to which these measures can supply refuge water may reduce or eliminate the need to curtail irrigation or eliminate the leasing program in any particular year in the Tule Lake NWR farming program.

2.3.1 Clear Lake

The Service believes that, consistent with the Solicitor's Opinion of July 25, 1995, Project water in Clear Lake could be made available for refuge wetlands in years in which supplies are limited from Upper Klamath Lake. Clear Lake is capable of storing water beyond the one year needs of agriculture. In some years, Clear Lake water may be available in the fall to flood refuge seasonal wetlands. In the fall of 2000, seasonal wetlands on Tule Lake and Lower Klamath NWR benefitted from the release of Clear Lake water outside of Langell Valley and Horsefly Irrigation Districts.

2.3.2 High-capacity Wells

The Service is exploring the feasibility of developing high-capacity wells on or adjacent to Lower Klamath and Tule Lake NWRs. Wells in these locations could supply water to refuge wetlands in below-average and dry-water years. Recent drilling of test wells on Lower Klamath NWR indicates that up to 20,000 acre-feet may be available for flooding of refuge wetlands. The Service is exploring the option of drilling production wells and conveyance facilities in 2001 to obtain this water. The Service is also exploring the option of purchasing water from adjacent landowners with operating wells to supply additional water.

2.3.3 Pre-irrigation of Tule Lake Lease Lands

Winter pre-irrigation of Tule Lake NWR lease lands could potentially use excess winter flows to store water in the soil profile for use in the subsequent growing season. This practice was commonly used on the refuge in the 1940's, before extensive drainage facilities were constructed. Winter pre-irrigation, similar to irrigation in Area K, would supply enough water for a small grain crop. If summer water supplies were adequate, irrigations in summer would allow for optimum small grain crops and growing of row crops. Saturating the soil profile in winter would also reduce the draw on Upper Klamath Lake during summer, potentially providing additional water for other Project purposes. This measure would require coordination and discussion with Reclamation and TID.

2.3.4 Water Storage

The refuge is exploring the feasibility of capturing and storing excess water flows during the winter and spring for use in maintaining permanent wetlands during the summer months. To this end, the Service recently purchased two properties from willing sellers adjacent to Lower Klamath NWR. During the winter/spring of 2000, the Service flooded these properties to the maximum extent possible. Although these properties were extensively used by shorebirds and nesting waterfowl during summer, they were dry during the fall waterfowl migration. Unless levees are raised to obtain additional depth, the storage option potential of these areas is poor.

2.3.5 May and June NRCS Forecast

In some years, significant precipitation falls in the Upper Klamath Lake watershed in April and May. The NRCS updates the April 1 forecast on the first of May and June with additional precipitation data collected in these months. If the May 1 and June 1 NRCS inflow forecast were to improve significantly (sufficient to provide water to both Refuge wetlands and agricultural lands), the Service would re-evaluate its decision based on the April 1 forecast and allow the agricultural leasing program to proceed based on these later forecasts.

Table 2.1 Comparison of alternatives

Issues	**Alternative 1** **(No action)**	**Alternative 2** Use of 1999 CD - Potential for Mid-season irrigation curtailment.	**Alternative 3** (Preferred) Use of 1999 CD - No mid-season irrigation curtailment.
Refuge Biological Resources	Managed Refuge wetlands on LK and TL 62-75% dry on Nov.1 in up to 46% of future years. Potential overcrowding of birds and disease, impacts to carrying capacity of the Basin and Pacific Flyway for wetland migratory birds.	In dry and below average water years, 14,000 to 29,000acre-feet of return flows potentially made available to Refuge wetlands. Potential mid season irrigation shut-off increases water available to Refuge wetlands in 9% of future years.	In dry and below average water years, 14,000-29,000acre-feet of return flows potentially made available to Refuge wetlands. No potential to capture additional water for Refuge wetlands through mid season irrigation shut-off if farming allowed but year is drier than expected (9% of years).
Socio-economics	Impacts to farmers and economics of local communities least of all alternatives.	Approximately a 50% chance of curtailing Apr-Sep irrigations in the Tule Lake NWR leasing program. If farming is curtailed, a loss of $14.5 million in gross agricultural revenues to local farmers, businesses, and agricultural support services. Increased risk of farming (potential for mid-season irrigation shut-off) will reduce lease revenues. Greatest economic impacts of all alternatives.	Approximately a 50% chance of curtailing Apr-Sep irrigations in the Tule Lake NWR leasing program. If farming is curtailed, a loss of $14.5 million in gross agricultural revenues to local farmers, businesses, and agricultural support services. Potential for impacts less than Alternative 2. Once agricultural program is authorized, no risk of irrigation curtailment.
Soil Erosion	Soil erosion potential greatest for this alternative because of spring cultivation in >90% of years.	Soil erosion potential less than No Action Alternative because lands not cultivated if leasing were curtailed.	Soil erosion potential less than No Action Alternative because lands not cultivated if leasing were curtailed.
Noxious Weeds	Noxious weed problems remain on dikes, berms, and no-spray buffer areas.	If leasing not permitted, weed problems would increase in subsequent years because of increased seed densities in fields. Weed problems may necessitate control activities by Service.	If leasing not permitted, weed problems would increase in subsequent years because of increased seed densities in fields. Weed problems may necessitate control activities by Service.

Issues	Alternative 1 (No action)	Alternative 2	Alternative 3 (Preferred)
Recreation	Greatest benefit to field goose hunters; least beneficial to more numerous non-consumptive wildlife users because of potential impacts to wetland habitats.	Some loss of goose hunters if farming does not occur, but greater benefits to non-consumptive wildlife users and duck hunters because of increased potential for flooded wetland habitats.	Some loss of goose hunters if farming does not occur, but greater benefits to non-consumptive wildlife users and duck hunters because of increased potential for flooded wetland habitats.
Agricultural food resources for waterfowl	Agricultural food resources more than adequate for waterfowl. Crop depredation potential least of all alternatives.	If farming curtailed, waterfowl may fly farther for food resources increasing energy expenditures. Increased feeding on private lands potentially increasing crop depredation.	If farming curtailed, waterfowl may fly farther for food resources increasing energy expenditures. Increased feeding on private lands potentially increasing crop depredation.
Public Controversy	Farmers accept this alternative; however, environmental groups concerned that Refuge purposes are not being met if water applied to croplands in priority over wetlands.	Environmental groups supportive of any alternative which places wetlands as first priority over agriculture on Refuge. Farmers and TID opposed to this alternative.	Environmental groups supportive of any alternative which places wetlands as first priority over agriculture on Refuge. Farmers and TID opposed to this alternative.

CHAPTER 3: AFFECTED ENVIRONMENT

Chapter 3 describes the existing environment, and resources that could effect or be affected by the proposed action or its alternatives. Resources are related to issues identified in Chapter 1.

3.0 BIOLOGICAL RESOURCES

The following discussion of habitats and fish and wildlife populations on Tule Lake and Lower Klamath NWRs centers around refuge goals and purposes including habitat protection and enhancement for endangered, threatened, and "sensitive" species, migratory birds, and preservation of biological diversity. Refuge purposes originate primarily with the establishing Executive Orders, Kuchel Act, and Refuge System purposes.

3.1 Tule Lake National Wildlife Refuge

Tule Lake NWR lies at an elevation of approximately 4,000 ft, and is comprised of 39,116 acres, consisting mostly of lands "reclaimed" from under the waters of historic Tule Lake. Generally, the topography is gentle with surrounding lands containing sparsely timbered hills, uplifts, and cinder cones. A small portion of the Refuge lying along the west boundary includes the steep hillsides and rock outcrops of Sheepy Ridge.

3.1.1 Habitats

Tule Lake NWR's habitats are comprised of approximately 17,000 acres of croplands, 640 acres of experimental wetlands, and 13,000 acres of sumps. The remainder of lands are comprised of sagebrush uplands and rocky outcrops. Potential cropland areas are identified in the Kuchel Act and are farmed via a cash lease arrangement with Reclamation under a Cooperative Agreement with the Service. Sump areas are managed, pursuant to regulations and contractual obligations between Interior and TID, as return-flow sumps, flood control sites, and wildlife habitat. Most of the sump area is comprised of open water dominated by submergent plant communities with extensive periodic blooms of filamentous green algae. Minimum water levels in the sumps are mandated by the 1992 Biological Opinion to protect the endangered Lost River and shortnose suckers.

Six-hundred-forty acres of experimental wetlands have been constructed on Tule Lake NWR to test the feasibility of the "Integrated Land Management". To date, these newly constructed wetlands have supported large waterfowl populations relative to their small acreage. Principal species and peak populations for the last 2 years (1996-97) include white-fronted geese (16,000), mallards (20,000), pintail (15,000), cackling Canada geese (5,000), and smaller numbers of tundra swans, shovelers, green-wing teal, and wigeon.

3.1.2 Wildlife/Fisheries Resources

3.1.2.1 Endangered/threatened species - Although Tule Lake NWR historically supported one of the larger populations of wintering bald eagles in the Klamath Basin (Keister et al. 1987), declines in waterfowl populations (primary prey item) on the refuge have reduced the ability of the refuge to

support bald eagles. In addition to wintering bald eagles, 2-8 breeding pairs of eagles forage on Tule Lake and Lower Klamath NWRs during the spring and summer (USFWS 1995). The occasional peregrine falcon is sighted during the fall and spring waterbird migration.

Historically, Tule Lake also provided suitable habitat for a large population of shortnosed and Lost River suckers (USFWS 1995); however, only a small remnant population of each remain due to the relatively small area of the lake >3 feet deep and poor water quality during the summer months.

3.1.2.2 Waterfowl migration habitat - Tule Lake NWR has a long history of use by waterfowl and at one time was considered the premier waterfowl refuge in North America. Although biological resources have declined significantly on this refuge since 1964, primarily because of sedimentation of wetlands, stabilized water levels, and a lack of wetland habitat diversity, the biological potential of Tule Lake NWR, if managed to enhance wetland productivity, is enormous.

Despite the loss of much of its productivity, Tule Lake NWR remains one of the most important waterfowl migrational staging areas in the Klamath Basin (Table 3.3), and regularly receives most of the Arctic goose use within the Klamath Basin in the fall. Important species and peak populations in 1997 include white geese (snow and Ross) (68,000), cackling (13,500), Canada (2,880), and Pacific white-fronted geese (32,500).

In addition to waterfowl, the sumps support large populations of fish eating birds during the spring and summer months. Sumps 1(A) and 1(B) represent the primary feeding locations for the large pelican breeding colonies at Clear Lake NWR.

3.1.2.3 Waterfowl Production - Tule Lake NWR produces an average of 4,665 waterfowl per year (Table 3.4), and during late summer is a focal point for molting waterfowl. From 50,000 to 100,000 waterfowl from throughout the Intermountain West and California spend the late summer flightless period (July - September) in the security of the refuge's emergent marshes.

3.1.2.4 Preservation of Biological Diversity - Because Tule Lake NWR has been significantly altered from its original condition, few elements of biological diversity remain.

3.2 Lower Klamath National Wildlife Refuge

3.2.1 Habitats

Lower Klamath NWR has been divided into a number of management units ranging from 63 acres to over 4,000 acres. Water in these units is manipulated to meet refuge purposes and goals as set forth by the establishing Orders and the Kuchel Act.

Many of the management units on the refuge are managed under a rotational management scheme which incorporates a variety of disturbance factors. This has proven the most efficient method of maintaining wetland productivity and the desired juxtaposition of different wetland habitats. Because of the rotational management, each habitat type will occupy a range of acreage. Acreage within these ranges are needed to meet refuge purposes.

3.2.1.1 Seasonal Wetlands (11,000-16,000 acres) - This habitat type occupied the shallow peripheral areas of the original Lower Klamath Lake system and is critical to meeting the migratory waterfowl goals of the refuge. In addition, this habitat provides brood areas for early nesting waterfowl species such as mallards (Mauser et al. 1994) and pintails, and is extensively used by spring migrant shorebirds and other wildlife species.

Management of seasonal wetlands requires application of water during the early fall (Sep - Nov) period with removal of water in late spring to early summer by gradually lowering the water level either by draining or by evaporation or a combination of both. This water management develops a productive wetland habitat that can be optimally utilized by migratory waterfowl and other wildlife.

The protracted removal of water during the growing season yields a complex mosaic of vegetative communities. Plant diversity is enhanced by uneven bottom contours which are exposed by a declining plane of water. As these "patches" of the bottom are exposed, they warm allowing germination of various plant species. Since these "patches " dry at different times, a specific plant association develops on each and results in a "patchwork" of differing plant associations in the unit. Many of these plant species produce large quantities of seeds which are readily used by fall migrant waterfowl (Pederson and Pederson 1983) when these marshes flood. The invertebrate populations that develop on the foliage after flooding are sought by many species of migrating waterfowl (Pederson and Pederson 1983), shorebirds (Helmers 1992), and other marsh birds during spring migration and subsequent breeding season. Aquatic invertebrates in particular are used by young waterfowl (Sugden 1973) and other breeding wetland wildlife species.

3.2.1.2 Permanent Wetlands (7,000-12,000 acres) - This habitat emulates the permanent emergent wetlands which typified the central deeper areas of historic Lower Klamath Lake. Permanent wetlands contain water year-round and are crucial to meeting the refuge goals of waterfowl production and habitat for fall and spring migrant waterfowl. In addition, permanent wetlands meet the habitat needs of several "sensitive" wildlife species (Table 3.2). These wetland units are characterized by year round flooding and contain two major plant communities. The emergent community is composed of hardstem bulrush and cattail with minor inclusions of river bulrush (*Scirpus fluviatilis*). The emergent vegetation provides nesting substrate for many species of waterfowl, wading birds, and passerine birds and acts as cover for resting waterfowl during periods of inclement weather.

The submergent plant community is dominated by sago pondweed with lesser amounts of baby pondweed (*P. pusillus*) and coontail (*Ceratophyllum demersum*). This community is found in open water zones where water depths range from 6 inches to 3 feet.

Sago pondweed is a major food source to migrating canvasbacks (*Aythya valisnaria*) which feed almost exclusively on sago tubers during their three month stay in the fall. Other species of waterfowl such as the redhead (*A. americana*), American wigeon (*A. penelope*), lesser scaup (*Aythya affinis*), mallard, American coot (*Fulica americana*), and tundra swan (*Cygnus columbianus*) consume the vegetative parts and seeds of this as well as other submergent plants.
The submergent plant community supports a diverse and productive invertebrate community. These are sought by many species of migratory waterfowl and other marsh birds. During the summer

months, invertebrates are a high protein food which meets requirements of breeding and molting waterfowl, grebes, and most ducklings. Breeding eared grebes (*Podiceps nigricollis*) and western grebes (*Aechmophorus occidentalis*) as well as coots utilize vegetative parts of submergent plants to construct their nests.

Colonial nesting species such as white pelicans, double-crested cormorants (*Phalacrocorax auritus*), and great blue herons (*Ardea herodias*) utilize permanent wetland units for nesting. These units provide secure and remote sites required for nesting, and provide an abundant supply of fish, the primary food item for these birds. The western pond turtle (*Clemmys marmorata*), a former Federal Category 2 species, is frequently sighted in Unit 2, a permanent wetland.

An additional use of permanent wetlands is by molting waterfowl (July - September). Because these birds are flightless during this period, food, water, and cover must be in close proximity. Large permanent wetlands on Lower Klamath are heavily utilized for this purpose. Ducks have been documented to travel over 300 miles from their nesting areas to these marshes to molt.

3.2.2 Wildlife/Fisheries Resources

3.2.2.1 Endangered/threatened species. - Of the three key bald eagle wintering areas identified in the Upper Klamath Basin (Keister et al. 1987), Lower Klamath NWR supports the greatest proportion of these birds. Bald eagles begin arriving in November, peak numbers are present in February, and most wintering eagles have left by the end of March. This refuge supports the largest concentration of bald eagles in the Klamath Basin (the Basin supports the largest population in the lower 48 states). In recent winters, numbers have peaked near 1,000 birds (Table 3.1). Eagles are attracted to the refuge because of the large waterfowl populations present. In addition to migratory eagles, 2-8 nesting pairs of eagles use the refuge as a foraging area during the spring and summer (USFWS 1995). Lower Klamath NWR represents a major feeding area for bald eagles which roost and nest in Bear Valley NWR. Bear Valley NWR is one of the most important communal winter roosts in the Klamath Basin and was established for this purpose.

Table 3.1.Peak Bald Eagle Populations Using Tule Lake and Lower Klamath National Wildlife Refuges, California and Oregon, 1992-97.

Refuges	1992	1993	1994	1995	1996	1997	Avg
Tule Lake	75	35	24	37	29	9	35
Lower Klamath	958	448	465	261	573	396	517

Although Lost River and shortnosed suckers have not been documented on the refuge, they are suspected to occur in Unit 2. Peregrine falcons are commonly seen during the fall and spring waterbird migration.

3.2.2.2 Sensitive Species - Breeding populations of greater sandhill cranes continue to increase on the refuge. Through the 1970's, 0-1 pairs of cranes were seen during aerial surveys of the refuge

(Littlefield 1982); however, by 1981, 6 pairs were present on (Littlefield 1982). Surveys conducted in the spring of 1997 indicate the presence of 12-15 pairs of breeding adults (Klamath Basin NWR, unpubl. data). Breeding cranes use both permanent and seasonal wetlands for nesting.

Lower Klamath NWR supports up to 1,000 sandhill cranes during the fall migration, making the refuge one of the largest fall staging areas for sandhill cranes in the Pacific Flyway. Fall staging cranes use refuge grain fields for feeding and shallowly flooded (<6 in.) seasonal marshes as night roosts. The greater sandhill crane is considered a threatened species by the State of California.

Lower Klamath NWR supports one of the last two breeding colonies of American white pelicans in California (the other being at Clear Lake NWR) and is rapidly becoming one of the major production areas for breeding white-faced ibis in the Intermountain West. In 1994, an estimated 8,477 ibis fledged from breeding colonies on the refuge (Follansbee and Mauser 1994). Recent investigations by the Point Reyes Bird Observatory indicate that Lower Klamath NWR is also one of the last remaining breeding colonies of California gulls in California (D. Shuford, Point Reyes Bird Observatory, pers. commun.) and is one of the most important breeding sites for inland nesting seabirds in Northeastern California (Shuford 1998). These species include American white pelicans, double-crested cormorants, and several species of gulls and terns.

Tricolored blackbirds nest in or adjacent to freshwater marshes (Ehrlich et al. 1988) and are listed as a "species of special concern" by the State of California and as a "sensitive" species by the State of Oregon. Follansbee and Mauser (1994) located 11 colonies in the Basin with 6 found on Lower Klamath NWR. Colony sizes ranged from 100-500 breeding individuals (Follansbee and Mauser 1994) and were located in or adjacent to refuge wetlands. The Northwestern pond turtle is commonly seen in Unit 2 on the west side of Lower Klamath NWR. Although no size estimate exists for this population, casual observation indicates it is as dense a population as any in the Basin. "Sensitive" species present on Lower Klamath NWR are depicted in Table 3.2.

3.2.2.3 Waterfowl Migration Habitat. -- Lower Klamath NWR is the single most important staging area for both fall and spring migratory waterfowl in the Pacific Flyway (Table 3.3). A peak population of 1.8 million waterfowl utilized the refuge in the fall of 1997. Because the peak population represents a one-time count, it is likely that upwards of 8-10 million waterfowl actually used the refuge during the fall migration. These birds are attracted to and dependant on the wide variety and juxtaposition of wetland habitats available on the refuge.

Table 3.2.Vertebrate species of special concern occurring on Lower Klamath National Wildlife Refuge, California and Oregon.

Species	Status	Species	Status
Bald eagle	2, 4, 8	Least bittern	6
White-faced ibis	6, 9	Western snowy plover	6,, 9
Long-billed curlew (inland population)	6	California gull	6
Tri-colored blackbird (breeding	6, 9	Yellow warbler	6
Lost River sucker (suspected to occur)	1, 4, 7	Shortnosed sucker (suspected to occur)	1, 4, 7
Western pond turtle	6	spotted frog	3
Swainson's hawk	5, 9	Peregrine falcon	1, 4, 7
Golden eagle	6	Ferruginous hawk	6
Northern harrier	6	Merlin	6
Prairie falcon (breeding)	6	Short-eared owl	6
Greater sandhill crane	5, 9	Bank swallow	5, 9
Willow flycatcher	4	American white pelican	6, 9
Double-crested cormorant	6		

1 = Federally endangered
2 = Federally threatened
3 = Federal category 1 species
4 = California endangered
5 = California threatened
6 = California "species of special concern"
7 = Oregon endangered
8 = Oregon threatened
9 = Oregon "sensitive species"

Table 3.3.Waterfowl use days[1] (x 1 million) for Lower Klamath and Tule Lake National Wildlife Refuges, Oregon and California, 1989-97.

Refuges	1989	1990	1991	1992	1993	1994	1995	1996	1997
LKNWR	50.6	78.7	65.5	76.3	66.3	89.5	102.3	102.4	143.3
TLNWR	36.8	27.8	28.4	24.4	25.1	29.4	23.8	22.8	27.9

[1] One use day is defined as one duck or goose on the refuge for one day.

Dabbling ducks (mallards, pintails, wigeon, gadwall, etc) are the predominant species; however, notable numbers of diving ducks, swans, and geese also utilize the refuge. In 1992, spring tundra swan populations (33,980) on Lower Klamath NWR approached 50% of the Pacific Flyway total (Klamath Basin NWR, unpubl. data). Since the early 1990's, peak canvasback numbers on the refuge have accounted for >50% of the total Pacific Flyway population observed during the Mid-winter Waterfowl Survey. In 1997, peak canvasback numbers exceeded 45,000 birds making Lower

Klamath NWR one of the most important staging areas for this species in the Pacific Flyway. Diving ducks and swans utilize permanent wetlands where sago pondweed is the preferred food while dabbling ducks prefer seasonal and permanent wetlands where a variety of seeds and aquatic invertebrates are consumed. Dabbling ducks, swans, and geese also make use of grain fields particularly during fall migration.

3.2.2.3 Waterfowl and Waterbird Production. - Lower Klamath NWR is a major waterfowl production area in the Intermountain West and supports one of the densest breeding populations of waterfowl in the National Wildlife Refuge System. Production over the last 5 years has averaged over 61,000 birds (Table 3.4). The refuge also produces a variety of colonial nesting water birds, including eared and western grebes, black-crowned night herons, great egrets, snowy egrets, and great blue herons. In addition, Lower Klamath NWR represents the most westerly breeding location for Franklin's gulls in the United States with 10-20 pairs present. Other breeding waterbirds include Forsters terns, least and American bitterns, sora and Virginia rails, Wilson phalaropes, American avocets, black-necked stilts, long-billed curlews, and willits.

Table 3.4. Waterfowl Production (ducks, geese, coots) from Tule Lake and Lower Klamath National Wildlife Refuges, California and Oregon, 1993-97.

Refuges	1993	1994	1995	1996	1997	Avg
Tule Lake	4,131	6,819	8,218	1,775	3,480	4,665
Lower Klamath	46,362	54,585	120,716	54,602	29,339	61,121

During the late summer, Lower Klamath NWR is a focal point for molting waterfowl with 50,000 to 100,000 birds present. Adult waterfowl from throughout the Intermountain West and California spend the late summer flightless period in the security of the refuge's permanent emergent marshes. Large emergent wetlands suitable as molting marshes to waterfowl are relatively uncommon in the Intermountain West.

3.2.2.4 Preservation of Biological Diversity. - Lower Klamath NWR is superimposed on historic Lower Klamath Lake. At one time the lake and associated wetland areas comprised in excess of 80,000 acres (21,157 acres of managed wetlands in 1998). The dynamics of seasonal and yearly hydrologic change greatly enhanced the biological productivity of this system. Because the refuge is an integral part of the Klamath Reclamation Project, this historic hydrology has been replaced by an extensive system of water control structures, canals, and drains. The refuge staff uses this system to manipulate water in refuge wetlands to enhance biological productivity and, where feasible, mimic the historic hydrology. Lower Klamath NWR is one of the most productive wetland areas in North America as evidenced by the numbers and diversity of wildlife species. Most of the 411 species of wildlife on the Complex are present on this refuge, many of which are "sensitive species" (Table 3.2).

3.3 TULE LAKE AND LOWER KLAMATH NWRS AND THE PACIFIC FLYWAY

Tule Lake and Lower Klamath NWRs are a major fall and spring staging areas for waterfowl of the Pacific Flyway. Currently, it is estimated that 80% of the waterfowl that pass to wintering areas in

California use the Klamath Basin. At any given time, these two refuges support 30-50% of the waterfowl in the Basin during migration. The waterfowl resource is the primary food source of wintering bald eagles in the Klamath Basin. Wetlands of these refuges are particularly important during dry water years when tens of thousands of acres of other Basin wetlands are dry. These refuges are key to achieving goals set forth in a host of Flyway management plans and agreements with other Nations, States, and Tribes, including:

1. Migratory Bird Treaty Act - Convention between the U.S. and Russia, 1976.

This agreement went beyond the original Act's regulation of hunting to preservation of habitat. "To the extent possible, the contracting parties shall undertake measures necessary to protect and enhance the environment of migratory birds and prevent and abate the pollution or detrimental alterations of that environment." The convention further states, "Each contracting party shall to the maximum extent possible, undertake measures necessary to establish preserves, refuges, protected areas, and also facilities intended for the conservation of migratory birds and their environment, and to manage such areas so as to preserve and restore the natural ecosystems." The Convention specifically identifies Tule Lake and Lower Klamath NWRs as areas of importance to migratory birds, particularly Wrangel Island snow geese, and Pacific white-fronted geese.

2. North American Waterfowl Management Plan

This 15-year plan signed by the United States and Canada seeks to enhance and protect continental habitat for 62 million breeding ducks, a fall flight of 100 million ducks, and 6 million wintering geese. The Plan's goal #6 seeks to "maintain the habitat value of designated areas of international significance to waterfowl." The Klamath Basin is specifically identified. Lower Klamath and Tule Lake NWRs routinely support approximately 50% of all the waterfowl in the Klamath Basin during fall migration.

3. Concept Plan for Waterfowl Habitat Protection - Klamath Basin, 1989

As part of the North American Waterfowl Management Plan, this document quantified habitat needs for waterfowl migration and production habitat in the Klamath Basin and found that present habitat in the Basin is insufficient to support population objectives of the North American Waterfowl Management Plan. In addition to current wetlands on State and Federal Refuges in the Klamath Basin, the Plan identified 30 properties totaling 98,940 acres in need of protection.

4. The 1995 Yukon-Kuskokwim Delta Goose Management Plan

The goal of this plan is to restore population levels of cackling Canada geese, emperor geese, Pacific white-fronted geese, and Pacific brant from nesting areas on the Yukon-Kuskokwim Delta to the Pacific Flyway wintering grounds. The parties to the plan are the U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, Association of Village Council Presidents, Associator's Waterfowl Conservation Committee, California

Department of Fish and Game, Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, and U.S. Geological Survey. Tule Lake and Lower Klamath NWRs are key fall staging areas for the Pacific White-fronted geese and cackling Canada geese.

5. Flyway Management Plans

In an attempt to coordinate management and protection of Pacific Flyway waterfowl populations among the Nations and States within the Flyway, Flyway Management Plans have been developed for the following species/populations. Lower Klamath and Tule Lake NWRs are fall or spring staging areas for all of these species.

Tule white-fronted goose
Pacific greater white-fronted goose
Western Arctic population of lesser snow goose
Wrangel Island snow goose
Ross goose
Cackling Canada goose
Western population of tundra swan
Greater sandhill crane

3.4 WATER RESOURCES

Lower Klamath NWR receives water from two primary sources: the ADY Canal and the P Canal system. The ADY Canal supplies water directly from the Klamath River, and because of its past reliability has been the key to providing water to maintain permanent marshes, especially in dry years. The ADY Canal is also used as a water source during fall flooding of seasonal wetlands. The importance of the ADY Canal to the refuge increases in dry years because of insufficient pumping from "D" plant.

P Canal water originates from "D" pumping plant on Tule Lake via a tunnel through Sheepy Ridge and services all units of Lower Klamath NWR except Area K (supplied by Klamath Drainage District) and Unit 2. In most years, the majority of water used for fall flooding comes from the P Canal system with lesser amounts from the ADY Canal.

Water delivery to Lower Klamath NWR is crucial during three time periods, summer (waterbird production), fall (fall waterbird migration), and spring (spring waterfowl and shorebird migration). Because of the hydrology of the Upper Klamath Basin and the competing demands for water, water for the summer and fall periods are most problematic.

3.5 AGRICULTURAL PROGRAMS

3.5.1 Lease Land Program

Pesticide applications to all farm lands within the Refuges including lease lands must adhere to Interior and Service Policy which includes preparation and approval of Pesticide Use Proposals prior to any pesticide applications. In addition, an Integrated Pest Management Plan has been prepared which will guide future agricultural operations to minimize applications of pesticides and improve the long-term sustainability of the agricultural program on both refuges.

3.5.1.1 Tule Lake: Tule Lake NWR (Figure 1) consists of 39,116 acres of which 15,500 are leased to local farmers under a program administered by Reclamation via a 1977 Cooperative Agreement with the Service. The Kuchel Act provides that agricultural leasing on Refuge lands must be consistent with proper waterfowl management. Similar to Lower Klamath NWR, leasing is by competitive bid. Leases are awarded in five-year increments with the option to renew each year. Approximately 20% of the leases are put out for bid each year with the remaining approximately 80% available for renewal. Tule Lake contains the more valuable croplands. Lease lands are comprised of 168 lots ranging from 60-120 acres each. Primary crops include barley, oats, wheat, sugar beets, onions, potatoes, and alfalfa. Barley, wheat, and oats comprise most of the acreage with potatoes the dominant row crop.

3.5.1.2 Lower Klamath NWR: Area K is the only lease land area on Lower Klamath NWR Pursuant to the 1977 Cooperative Agreement between the Service and the Bureau, this area is leased by the Bureau of Reclamation on a competitive bid basis. Leases are for five years with an annual option to renew with the same approximate percentages of new leases and renewals as on Tule Lake. Area K consists of 43 individual lots ranging from 102 to 160 acres each for a total of 6,254 acres. Primary agricultural practices include grazing, haying, and the growing of barley, oats, and wheat. All lease lots are pre-irrigated from November - January with water removed from February - March. Planting of small grains is generally completed by early June. Because of the high water-holding capacity of the soils, no summer irrigation is required for small grains. Hay and pasture lands undergo additional flood irrigation in summer.

3.5.2 Lease Revenues

Annual lease revenues to the government have ranged from a low of $1.2 million (in 1980) to a high of $2.4 million (in 1984) (Table 3.5). If inflation is considered, lease revenues in the 1990s are considerably less than they were in the early and mid-1980s.

Lease bid rates are affected by the productivity of individual parcels, the mix of crops permitted to be grown on the land, lease stipulations, and anticipated market prices for crops. Lease revenues tend to be greatest from parcels where row cropping is allowed. Growers bid more for highly productive lands which are free of detrimental insects, crop diseases and weeds. Market prices were very favorable in the early 1980s. Lower commodity prices in the 1990s resulted in less revenues being generated by the leased lands. None of the Lower Klamath or Tule Lake agricultural lease revenues are directly used to fund Reclamation or Service operations in the Basin. Lease revenues are deposited in the Federal Treasury and the agencies are funded under congressional and agency budgetary processes.

Table 3.5. Summary of Tule Lake and Lower Klamath National Wildlife Refuge agricultural lease land acreage and revenues, 1980-96. (In nominal $/ unadjusted for inflation)

Year	Lease Revenues in $	Acres Leased	Average Lease Payment in $ Per Acre
1980	$1,248,704	22,962	$54
1981	2,443,844	21,873	112
1982	2,005,441	22,040	91
1983	2,394,932	21,912	109
1984	2,414,613	21,919	110
1985	2,488,155	22,039	113
1986	2,114,371	21,754	97
1987	1,713,853	21,315	80
1989	1,538,880	21,436	72
1989	1,576,778	21,537	73
1990	1,673,123	21,179	79
1991	1,791,951	21,062	85
1992	1,492,735	21,427	70
1993	1,756,115	21,576	81
1994	1,737,093	21,576	81
1995	1,740,085	21,264	82
1996	1,884,026	21,839	86

3.5.3 Historical Variation in the Value of Agricultural Production

In the 1980s and ‘90s, yearly aggregate values for crops grown within the two refuges have ranged from about $11 million in 1987 to about $22 million in 1995 (Fig. 3). The market values for agricultural commodities have not kept pace with inflation. If 1995 dollars were adjusted for inflation, Refuge agriculture sales were exceeding $30 million in the early 1980s compared to less than $20 million during much of the 1990s.

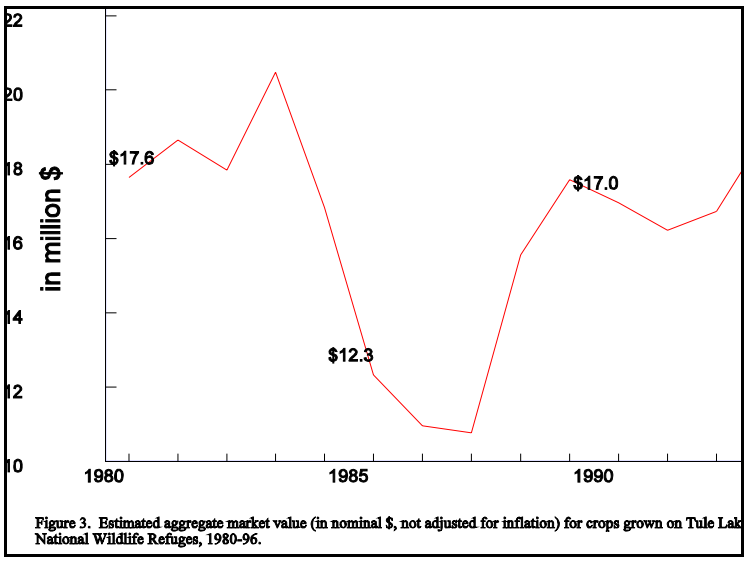

Figure 3. Estimated aggregate market value (in nominal $, not adjusted for inflation) for crops grown on Tule Lak National Wildlife Refuges, 1980-96.

Table 3.6. High, low, and median average crop yields on Tule Lake and Lower Klamath National Wildlife Refuges, 1980-96.

Crop	High Yield	Low Yield	Median Yield
Barley	130 bu./acre (1993)	94 bu./acre (1988)	115 bu./acre
Wheat	117 bu./acre (1995)	75 bu./acre (1988)	96 bu./acre
Oats	180 bu./acre (1993)	94 bu./acre (1988)	123 bu./acre
Sugarbeets	26 tons/acre (1994)	20 tons/acre (1995)	22 tons/acre
Onions	510 cwt/acre (1987)	378 cwt/acre (1995)	440 cwt/acre
Potatoes	450 cwt/acre (1982)	380 cwt/acre (1990)	400 cwt/acre
Alfalfa	6 tons/acre (1995)	4 tons/acre (1991)	5 tons/acre
Other Hay	5 ton/acre (1993)	3 ton/acre (1983)	4 tons/acre

[1] The above information is based on yield estimates for the entire Tule Lake Irrigation District; actual production levels for Refuge leases may be slightly higher

3.5.4 Crops

The Lower Klamath and Tule Lake NWRs lie within the Intermountain Region, characterized by hot summers and cool winters. Elevation ranges between 4,100 and 4,300 feet. The growing season is short, usually lasting from May to September. Frost may occur any month of the year. Annual precipitation averages about 12 inches, but there is considerable variation from year to year. Crops currently grown on the refuges include potatoes, sugarbeets, alfalfa, onions, and small grains including barley, oats, and wheat.

Potatoes-About 3,200 acres of potatoes, representing a wide number of varieties, are planted on the Tule Lake leased lands annually. Most of leased-land potatoes, as in the rest of the Basin, are grown for the fresh market. No seed potatoes are grown on the refuge. Fresh market crops are processed in about 20 locally owned packing sheds and sold primarily in California population centers.

The short growing season, punctuated with mid-season frosts was a major obstacle to potato production until introduction of solid-set sprinkler irrigation, which can protect against short-duration frosts down to 25 degrees F. Although the short growing season may limit yields, particularly for late-maturing varieties, the leased lands have two distinct advantages over most other potato production areas in the U.S. First is the exceptional soil quality. Second is the absence of the Colorado potato beetle. Recent (1997) appearance of late blight has significantly increased production costs and risks in the Basin.

Alfalfa - Roughly 600 acres of alfalfa are currently grown on Tule Lake leased lands. Winter dormant varieties are grown to insure protection of the plants from cold-weather injury. Growers usually obtain 3 cuttings per year between May and September. Total seasonal production is estimated at 4 to 6 tons per acre and stand life is long; 6 to 8 years is common. Forage quality is high, attributable to the short growing season and cool night temperatures.

Onions - Onions are grown on roughly 400 acres of the Tule Lake NWR, and are rotated with grains and other row crops. Both dehydrating and fresh market onions are grown. Onions are planted on less acreage than other refuge-grown row crops, but their net return per acre is high.

Sugarbeets - Sugarbeet production in the Klamath Basin has expanded from approximately 1,000 acres in 1990 to 11,000 acres in 1995. Production on Tule Lake NWR is roughly 600 acres. Modest beet yields (18 to 23 tons/acre) are offset by the high sugar content of Basin-grown beets. The high quality of these sugarbeets combined with the relative lack of pests that plague other sugarbeet growing areas explains the rapid expansion of this crop in recent years. All beets are grown on contract. Local production costs for sugarbeets have been kept to a minimum because control measures have not been necessary for pests.

Small Grains - Small grains are planted on roughly 100,000 acres in Klamath Basin. Barley is the predominant crop, making up roughly 80 percent of small grain acreage, with spring wheat and oats a distant second and third, respectively. A similar situation exists on the leased lands, where 10,200 acres of barley, 3,400 acres of oats, and 1,700 acres of wheat are grown. Much of this acreage is grown on the Lower Klamath Refuge. Grains are grown in the Tule Lake Refuge in rotation with row crops. On Lower Klamath, grains are planted every year after a period of flooding in the winter. Each spring, the stubble from the previous year is burned prior to working the soil in preparation for planting.

3.5.5 Cropping Trends on Lease Lands

Grains - From 1980 through 1996, the portion of leased land devoted to grain production has fluctuated from 14,000 to about 17,000 acres (Table 3.6). Barley is the most widely grown crop

on leased lands; an average of 47 percent of these lands have been devoted to barley production (1980-1996).

Table 3.7. Acres planted by crop type on Tule Lake and Lower Klamath National Wildlife Refuge lease lands, 1980-96.

Year	Barley	Wheat	Oats	Rye	Sugar-beets	Onions	Potatoes	Pea Seed	Alfalfa	Other Hay
	acres	acres	acres	acres	acres	acres	acres	acres	acres	acres
1980	10,435	646	3,697	3	0	0	2,291	0	371	3,529
1981	11,076	720	4,564	0	0	329	2,453	0	431	3,032
1982	11,236	533	4,972	0	0	441	2,603	0	492	2,503
1983	10,520	962	5,311	0	0	435	2,652	0	574	2,365
1984	10,502	750	5,147	0	0	134	2,945	0	660	2,311
1985	9,963	1,044	5,189	0	0	224	3,262	0	803	2,194
1986	9,238	1,431	3,168	0	0	647	2,788	0	704	2,217
1987	8,800	1,329	3,966	0	0	410	3,071	0	491	2,181
1988	10,704	835	3,956	0	0	573	2,436	0	401	2,075
1989	9,027	1,939	5,768	0	0	613	2,727	0	598	1,948
1990	9,941	1,942	4,429	0	0	614	3,037	53	666	1,940
1991	10,096	1,681	4,156	0	265	947	2,224	0	765	2,340
1992	11,491	1,930	2,948	0	456	160	2,226	0	707	1,940
1993	9,456	1,717	3,155	0	607	318	2,919	0	512	2,010
1994	9,798	1,797	2,927	0	699	134	2,893	102	749	1,819
1995	10,623	1,757	3,691	0	658	318	2,909	0	712	1,802
1996	10,277	2,054	3,110	0	818	387	2,625	0	906	1,806

Oats and wheat are the other grains grown on leased lands. Both crops have experienced cycles of increasing and decreasing interest. Rye was grown on Refuge lands in the early 1980s, but has been discontinued due to lack of a strong market.

Row Crops - There are important differences in cropping patterns between the two refuges. Row crops are grown on Tule Lake, but not on Lower Klamath. Potatoes are the main row crop grown within Tule Lake leased lands -- 2,300 to 3,000 acres of potatoes were grown on Tule Lake NWR in the 1980s and 90s. Potatoes historically have provided farmers with a higher dollar value per acre than other crops grown on the Refuge.

Sugarbeets and onions are the other row crops being produced on the Tule Lake Refuge. Sugarbeets were first introduced in 1991. From 1991 through 1996, Refuge land devoted to sugarbeets has increased from 265 to over 800 acres. Closure of sugarbeet processing plants in California and subsequent loss of contracts to local growers will eliminate or sharply reduce the acreage of sugarbeets on the lease lands as well as within the Basin. Onion production has varied significantly from year to year. In 1996, about 400 acres were in onion production.

Hay - Alfalfa is grown on Tule Lake lands, while grass hay is grown on Lower Klamath. Alfalfa acreage gradually has been increasing on the Tule Lake to more than 900 acres in 1996. The amount of Lower Klamath land devoted to grass hay production has decreased from 3,500 acres in 1980 to 1,800 acres in 1996. Some of these former hay lands are now devoted exclusively to wildlife habitat while other land has been converted to grain production.

3.5.6 Crop Yields and Values on Lease Lands

By a significant margin, potatoes generated the highest gross dollar value per acre ($2,660/acre) (Table 3.7). Onions were the second most value-intensive crop ($1,625/acre). Sugarbeets generated an average of $878 per acre in gross income. Gross market values for barley, wheat, and oats ranged from $245 to $453 per acre. The market value for alfalfa hay ($570/acre) was higher than the price received for grass hay ($320/acre).

Table 3.8. Average dollar returns by crop type.

Crop Average, Gross $ Value Per Acre	
Barley	$342
Wheat	453
Oats	245
Sugarbeets	878
Onions	1,625
Potatoes	2,660
Alfalfa	570
Other Hay	320

Row crop production also involves higher expenditures for leases, labor, equipment and machinery, seed, fertilizer, and pest and weed control. In years with high productivity and favorable prices, row crop leases are likely to achieve greater net profits than leases devoted to grains and hay. However, because of the higher costs of farming inputs, the risk of major financial losses also is much greater for row crop growers.

3.5.7 Cooperative farming program

Cooperative farming occurs on both refuges. Under the program, local farmers provide all costs of producing a small grain crop and in return leave 25-33% of the crop standing and harvest the remainder of the field for themselves. Participants in the program are selected by lottery, and farm under 1 year agreements for a period of 3-5 years. The purpose of the program is to provide food for fall migrant waterfowl and cranes and provide depredation relief for the lease lands and adjacent private lands.

3.5.7.1 Tule Lake NWR

Cooperative farming is conducted on 1,532 acres divided into seven lots immediately adjacent to Sumps 1(A) and 1(B) on Tule Lake NWR. Only small grains (oats, barley, and wheat) are grown on these lots and irrigations practices are similar to the Tule Lake NWR lease lands. These lots are awarded at no charge on a lottery basis with the cooperator suppling the costs of production including water, and leaving 33% of the barley unharvested for consumption by waterfowl.

3.5.7.2 Lower Klamath NWR

Cooperative farming on Lower Klamath NWR occurs on 3,500 to 4,500 acres via five lots. Up to one half of each lot can be planted to oats with the remainder in barley. Under this program, the farmer supplies materials and labor needed to establish the crop and leaves 25% standing for waterfowl use. In addition to depredation and wildlife use purposes, on Lower Klamath NWR, specific fields are managed on a 5-year rotation where the farming activity is used as a tool to maintain some seasonal wetlands in an early successional stage. Early successional wetlands produce large quantities of annual plant seeds, that when flooded, are highly attractive to waterfowl. Similar to small grain lots in Area K, these fields receive only one irrigation during the winter period.

3.6 SOCIOECONOMICS OF THE REGION from USFWS (1998)

Siskiyou and Modoc counties in northern California, and Klamath County in Oregon comprise the tri-county area influenced most greatly by activities on the Lower Klamath and Tule Lake NWRs. Klamath Falls, Oregon is the area's economic center, while Klamath County contained over half of the tri-county's 114,000 residents in 1994 (Laughland and Caudill 1997).

Employment in the region totaled 54,151 in 1994 with 60 percent of the total workforce employed by services, government, and retail trade. Local per capita income averaged $16,375 in 1994, about $5,000 below the national average for the same year (U.S. Bureau of Economic Analysis 1997). Agriculture is important to the local economy. Aside from agricultural producers, the industry includes crop scouting businesses and agricultural suppliers. Agriculture accounted for 7.5 and 6.4% of employment in Klamath and Siskiyou counties, respectively, and 16.2% in Modoc County.

There were 2,451 agricultural operators in the tri-county region in 1995, and 75 leaseholders on the refuges in 1996. Assuming the number of agricultural operators remained stable, leased land growers represented 2 % of the tri-county total in 1996.

While Klamath Falls is the economic hub of the tri-county area, smaller towns are also affected by visitation and farming on the refuges. Total expenditures were estimated at $700,400 for visitor recreation at Tule Lake NWR alone in Fiscal Year 1995. It is estimated that for every $1.00 spent at the Refuge, $1.50 in revenues is generated by recreational visitation (Laughland and Caudill 1997).

In 1996, $1.9 million in lease land fees were collected from the leased lands. This money was returned to the U.S. Treasury and was not used to fund the leased-lands or other refuge programs. However, the Kuchel Act directs how the leased-land revenues will influence the Payment-In-Lieu-of-Taxes the Federal Government pays Siskiyou, Modoc, and Klamath counties. In 1996, Modoc Siskiyou, and Klamath counties received $32,994, $166,773 and $10,381 in leased-land revenues, respectively.

Total county budgets for Modoc, Siskiyou, and Klamath counties were $17.2, $57.2, and $139.8 million respectively, in 1996. Thus, leased-land revenue payments represented 0.18, 0.29, and 0.007 percent of affected county budgets, respectively. TID also receives payment equal to 10% of net leased-land revenues under the Kuchel Act. In 1996, this amounted to a $128,000 payment; or 8% of TID's $1.6 million budget for 1996 (Earl Danosky, TID, pers. comm, April 13, 1998).

3.7 SOIL RESOURCES

Soils on the Tule Lake NWR are some of the most productive agricultural soils in the Basin because they have 5 to 15% organic matter, are well drained, and deep. These deep muck soils were formed when the land was covered with water. Much of this irreplaceable soil is currently subject to wind erosion. Lease land soils on Lower Klamath NWR are also productive, but not as good as those on Tule Lake.

Grain stubble and alfalfa reduce wind-blown erosion on two-thirds of the cropland acreage on Tule Lake NWR. The remaining one-third is row crops which are allowed under the Kuchel Act. A new required lease stipulation states "A cover crop shall be established by the following spring on all harvested row crop acreage by planting a fall/winter sprouting cover crop (grasses, small grains, legumes or other species) known to be adapted to the Klamath Basin...". This will have the effect of significantly reducing the potential for soil erosion.

3.8 RECREATION

3.8.1 Lower Klamath NWR

Lower Klamath Refuge attracts visitors from a wide geographic area due to the great diversity and numbers of wildlife observed there and excellent opportunities for waterfowl hunting on the Refuge. Public use estimates of 230,900 visits annually (1997 Public Use Report) for various activities on Lower Klamath Refuge are itemized below:

Outdoor Exhibits	3,900 visits
Auto Tour Route	40,400 visits
Photography	2,200 visits
Wildlife Observation	188,000 visits
Waterfowl Hunting	11,400 visits
Pheasant Hunting	345 visits
Picnicking	740 visits

Interpretation and nature observation visits to the Refuge include use of outdoor exhibits near the Refuge entrance and the pull-off along Highway 161, driving the Refuge's popular 12-mile auto tour route, photography, and general wildlife observation which occurs on various Refuge roads, as well as along Highway 161. As can be seen from the figures listed above, wildlife observation comprises the majority of public use visits to the Refuge. Several peak use periods for wildlife observation occur each year including the spring and fall waterfowl migration period (March/April and October/November respectively), the concentration period for wintering bald eagles (January/February), and the spring breeding season (mid-May/mid-July).

Lower Klamath Refuge runs a large waterfowl hunting program which offers a diversity of both duck and goose hunting opportunities. This program may be the largest managed waterfowl hunting program (when considered in combination with the Tule Lake hunt) on any Refuge in the country. The program attracts hunters from great distances for multiple-day hunts with resulting significant impacts on the local economy. Fifty-four percent of hunters travel from 150-400 miles (straight line distance) to hunt on Tule Lake and Lower Klamath NWRs, with an additional 14% of hunters traveling over 400 miles (Klamath Basin NWR, unpublished data).

The U.S. Fish and Wildlife Service, Division of Economics published an analysis of the economic benefits of Tule Lake and other Refuges titled *Banking on Nature*. This analysis was based on FY 1995 public use totals of approximately 195,500 visits to Tule Lake Refuge. The benefits estimated for Tule Lake Refuge are similar to those generated by nearby Lower Klamath Refuge (which has similar visitor characteristics and use levels). The economic benefits to the local communities estimated in this report are $488,800 for non-consumptive uses and $212,600 for hunting, for a total of just over $700,000 per year in local economic benefits. Using these figures and noting approximately double the number of hunters using Lower Klamath NWR, the local economic benefit for Lower Klamath NWR is estimated to be $900,000 for the purpose of the following analysis.

3.8.2 Tule Lake NWR

Tule Lake NWR had an estimated 235,500 visitors in 1997. Both visitor use numbers and characteristics are similar to nearby Lower Klamath NWR. Many visitors combine tours of both Refuges starting at the Tule Lake Visitor Center which is staffed seven days per week. Visitors then typically drive both the Tule Lake and Lower Klamath auto tour routes to observe wildlife. The Refuge Visitor Center also serves as the starting point for many environmental education activities which may later include a tour of one or both Refuges.

Public use estimates of various activities occurring on Tule Lake NWR in 1997 are itemized below.

Visitor Center	11,800 visits
Outdoor Exhibits	4,400 visits
Auto Tour Route	18,800 visits
Foot Trails	1,400 visits
Photography	829 visits
Wildlife Observation	200,900 visits
Environmental Education	2,040 visits
Waterfowl Hunting	4,200 visits
Pheasant hunting	200 visits
Picnicking	3,300 visits

Interpretation and nature observation account for the vast majority of public use activities on Tule Lake NWR with peak use periods similar to those on Lower Klamath NWR. Uses in this category include visitor center stops, auto tour route, general wildlife observation, foot trail, outdoor exhibit, and photography. Many visitors participate in two or more of these activities during trips to the Refuge. A small sales area in the visitor center has total annual sales of approximately $20,000. Visitors also have access to the Discovery Marsh, across the road from the visitor center and other outdoor exhibits.

Tule Lake NWR offers waterfowl hunting programs for goose and duck hunting. Hunting levels have decreased significantly in this Refuge over the past twenty years, due to declines in waterfowl numbers and a state-wide (CA) decline in waterfowl hunters. As noted above, a small number of hunters also hunt pheasant on Tule Lake NWR.

About 2,000 students participate in structured educational activities each year. These experiences may entail use of the visitor center, discovery marsh and then include a tour of either the Tule Lake or Lower Klamath NWR auto tour routes.

The U.S. Fish and Wildlife Service, Division of Economics published an analysis of the economic benefits of Tule Lake NWR based on FY 1995 use figures of approximately 195,500 visits. The economic benefits estimated in this report are $488,800 for non-consumptive uses and $212,600 for hunting to the local communities for a total of just over $700,000 per year in local economic benefits.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

4.0 INTRODUCTION

Chapter 4 contains the Service's analysis of probable impacts to the environment that would result from implementation of the proposed action (Alternative 3) or one of the alternatives. The analysis focuses on issues identified in Chapter 1. Critical water years (<186,000 acre-foot inflow to Upper Klamath Lake, Apr-Sep) were not factored in this analysis because of the high probability for significant changes to Project Operations in this water year type. If a critical year occurs, the Service will re-evaluate potential impacts of the farming program on water supplies for refuge wetlands.

Alternative 1 represents the historic farming program prior to implementation of the 1999 CD. Alternative 2 and Alternative 3 are identical in that the decision to lease would be based on the NRCS February 70% and/or April 50% exceedance forecasts. However, they differ in that Alternative 2 allows for withdrawing of leases or a mid-growing season irrigation shutoff in the Tule Lake NWR farming program and Alternative 3 does not. This difference results in differences in potential economic impacts as well as water "savings" in the agricultural program which could be used in refuge wetlands.

4.1 ALTERNATIVE 1: (No Action) Historic Refuge farming prior to 1999 CD.

Analysis of this Alternative assumes that Reclamation will operate the Project similar to the 1999 Project Operations Plan. It should be recognized, however, that this plan was written for an above average water year. Whether different river flows will be adopted by Reclamation in the future is currently unknown. If lower river flows and/or lake levels are adopted, impacts depicted under Alternative 1 (No Action) represent a worst case scenario. However, the river flows and/or lake levels that are likely will still leave significant impacts to Refuge wetlands (See wetland impacts estimated from 1998 Operations Plan as described in the Service's Draft Discussion Paper issued March 1999). Under Alternative 1, analysis conducted by Service hydrologists indicates that refuge wetlands may experience severe water shortages in a large proportion of future years (Tables 1.1 and 1.2). **The following analysis summarizes potential impacts to wildlife and wetlands on Lower Klamath and Tule Lake NWRs in years of water shortages where water that could have been used in Refuge wetlands was instead used within the farming program.** In years of adequate supplies for both wetlands and the agricultural program, impacts to Refuge wetlands and biological resources are negligible.

4.1.1 Biological Impacts to Refuge

4.1.1.1 Tule Lake NWR

Although the 640 acres of managed wetlands are small compared to the 13,000 acre sumps, they are important habitat to pintails, mallards, green-wing teal, and white-fronted geese. Under Alternative 1 (No action), reductions to these wetlands could occur with up to a 45% probability (Table 1.2), reducing use by up to 16,000 white-fronted geese, 20,000 mallards, 15,000 pintail,

5,000 cackling Canada geese, and smaller numbers of tundra swans, shovelers, green-wing teal, and wigeon (Klamath Basin NWR, unpubl. data).

4.1.1.2 Lower Klamath NWR

Wetlands **-** Under this alternative, there is a 45% probability that permanent wetlands on Lower Klamath NWR could be reduced by 65-75% (Table 1.1) during July and August. Drying of permanent wetlands may kill large numbers of forage fish, submerged aquatic plants, and invertebrates, all of which are key food items or habitat components for breeding waterbirds. Unit 2 (4,499 acres) represents the last vestige of the original marshes from historic Lower Klamath Lake and would be the most heavily impacted by projected water shortages. The ADY Canal is the only summer water source to this marsh. Other permanent wetlands can be supplemented by water from declining seasonal marsh levels in May; however, this option does not exist for Unit 2. Many elements of biological diversity present from historic Lower Klamath Lake would likely be lost.

Seasonal wetlands on Lower Klamath and Tule Lake NWRs are watered from September to November with water removed in April to June. Water is applied to most seasonal wetlands prior to November 1, which is the typical peak of fall migration. The proportion of seasonal wetlands dry in years of water shortages (Table 1.1) may cause over-crowding of birds, possibly exacerbating disease problems. The same year types in which refuge wetlands are impacted are the same years in which other wetlands in and around the Klamath Basin are also dry, increasing the need for wetland habitats on the refuge.

The sharp reduction in seasonal wetlands coupled with the lack of permanent marshes could have severe consequences for the ecological integrity of Lower Klamath NWR. Lower Klamath NWR is the most biologically productive freshwater wetland in the Klamath Ecoregion (Figure 3) and is a key to the overall carrying capacity of the Pacific Flyway (Figure 4) for a variety of waterbird species. The following discussion relates to impacts which would occur if the refuges did not receive an adequate supply of water. In years in which water was not in short supply, impacts would be negligible.

Threatened and Endangered Species **-** If reduced quantities of water are received during the summer months, water remaining in seasonal wetlands and drying permanent wetlands would probably support enough wetland birds to sustain the 2-8 pairs of bald eagles nesting in the surrounding areas through the young-rearing phase. Once young have fledged in late July or August, young and adults would likely forage elsewhere to obtain sufficient food resources, presumably at higher energetic costs, which may reduce survival.

Seasonal wetland habitats are the key attractant to fall migrant waterfowl, a key food item of bald eagles. Although, sufficient flooding of marshes would probably occur by December due to winter precipitation in the local watershed, most waterfowl would already be on the wintering areas in California. Peak waterfowl populations on Lower Klamath NWR typically occur near or just prior to November 1.

Over the last five years, wintering bald eagle use of other areas in the Basin has declined markedly, indicating that Lower Klamath NWR is the preferred habitat for these birds. If the prey base (waterfowl) was reduced on Lower Klamath NWR, eagles would either feed elsewhere or leave the Basin. Either scenario would probably result in higher energetic costs which may reduce body condition, over-winter survival, and subsequent breeding success. Impacts would be greatest in severe winters when eagles are concentrated in high numbers within the Basin. During winter, the only other large waterfowl concentration area in the Pacific Flyway is the Central Valley of California. Despite large concentrations of waterfowl (2-6 million birds) and annual waterfowl disease events which leave a potentially abundant food source for eagles, the Central Valley winters a relatively small bald eagle population. Possible reasons for a lack of eagles in the Central Valley include a lack of suitable roost trees and/or high levels of human disturbance.

Sensitive Species - The reduction of permanent wetlands (Table 1.1) may have negative impacts to several sensitive species. Golden eagles, harriers, merlins, and prairie falcons would be impacted by the loss of habitat for potential prey items (wetland birds). The degree to which the birds would then forage in areas outside the refuge or on alternative prey items is unknown, although it is likely that the change to new foraging sites or prey items would probably be energetically costly, potentially reducing survival. It is also probable that these species would be displaced to already occupied habitat and would again experience lower rates of survival.

The reduction of permanent wetlands on Lower Klamath NWR would reduce fish resources, the primary food source of American white pelicans and double-crested cormorants, as well as a food for other colonial nesting waterbirds including the white-faced ibis and California gull. The lack of foraging habitat for white-faced ibis and California gulls could reduce foraging success and lead to reduced reproductive performance. Because of the high nest site fidelity of white pelicans to traditional locations, drying of permanent wetlands on Lower Klamath NWR (particularly Unit 2), may eliminate one of the last two breeding colonies of this bird in California.

Return of fish to suitable sizes and density to previously dried permanent wetlands would likely require 2-3 years of continuous flooding. Lack of fish resources would sharply reduce use and production of other fish-eating water birds including western grebes, black-crowned-night herons, great blue herons, and great and snowy egrets. In addition to fish, the reduction of permanent wetlands would reduce submergent plant communities and aquatic invertebrate populations, thereby negatively impacting reproductive output of many wetland bird species.

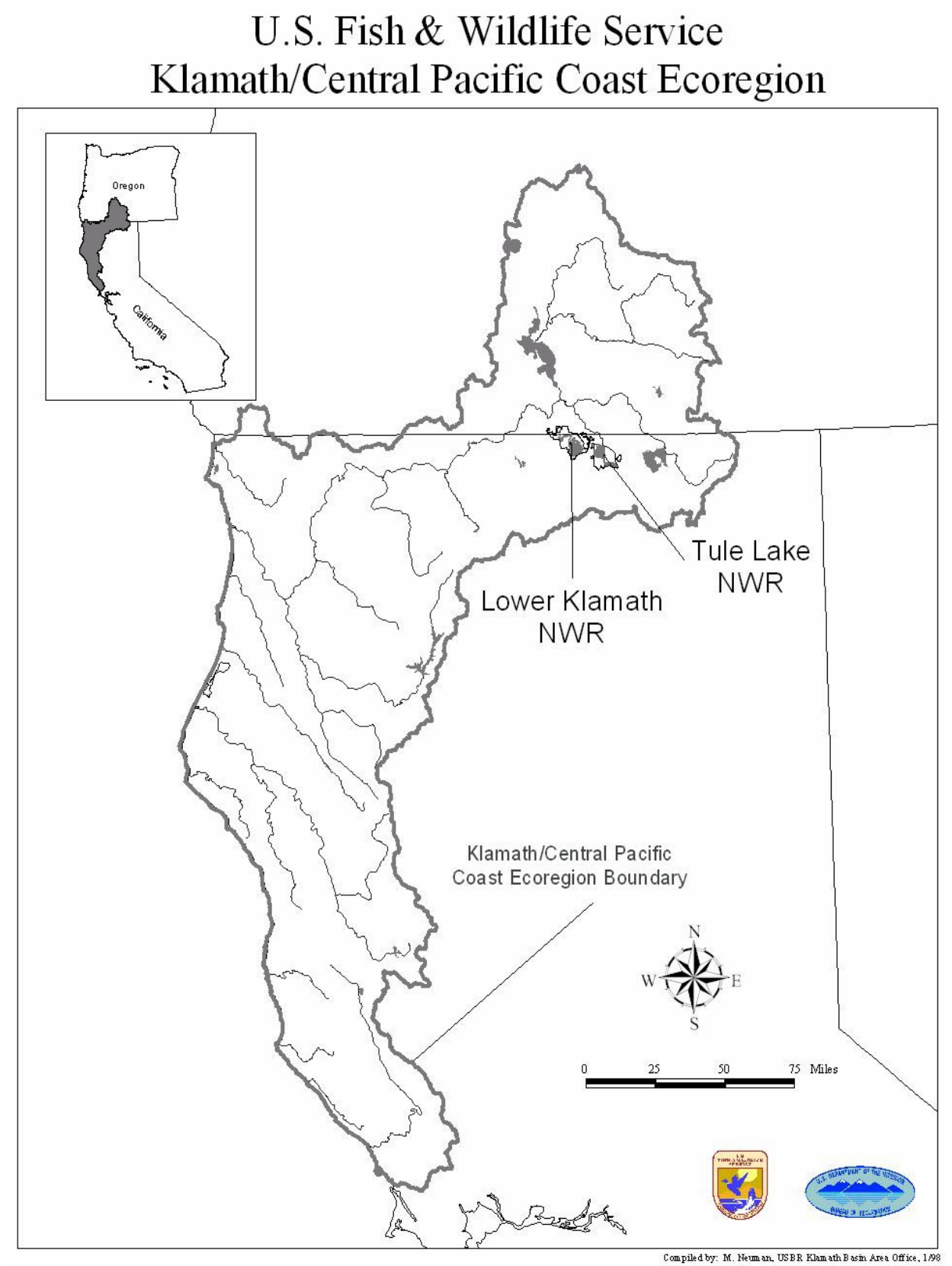

Figure 3. Klamath/Central Pacific Coast Ecoregion Boundary.

Figure 4. Pacific Flyway

The western pond turtle is found primarily in Unit 2 and sporadically in other areas of the refuge. The ADY Canal is the primary source of water to Unit 2; therefore, elimination of this water source, as depicted in KPOPSIM in some years, could lead to >80% reductions in turtle numbers. If consecutive years of drying occurred, populations could be reduced by >95%. Western pond turtles are a long-lived species possessing a limited reproductive capacity, thus their ability to rebound quickly from habitat loss is limited.

Fall Migratory Waterfowl - Assuming the above-mentioned impacts to permanent and seasonal wetlands, there would be a major loss of waterfowl habitat in the Upper Klamath Basin and the Pacific Flyway (Figure 4), especially considering the importance of Lower Klamath NWR to Basin populations and to the Pacific Flyway as a whole. From 1993-97 the Refuge's peak waterfowl population represented 15-31% of the flyway populations subsequently wintering in the Central Valley of California (California's Central Valley is the major wintering area in the Pacific Flyway). Reduction in wetland habitat of the magnitude which may occur under this alternative has the potential to seriously degrade the Upper Klamath Basin as a primary fall staging area for 80% of Pacific Flyway waterfowl (2-6 million waterfowl) and reduce the overall carrying capacity of the Pacific Flyway to support present waterfowl populations.

Drying of large areas of permanent wetlands would nearly eliminate sago pondweed from the refuge, eliminating use of the refuge by canvasback and tundra swans and significantly reducing use by widgeon, redheads, scaup, and ruddy ducks. Lower Klamath NWR currently supports one of the largest canvasback populations in the Pacific Flyway (1997 peak population of 45,500 birds).

Waterfowl Production - During years in which permanent wetlands dry in late summer, waterfowl production from late nesting species such as gadwall, ruddy duck, and redheads could be reduced by 60-80%. Earlier nesting species such as mallards, pintails, and cinnamon teal would likely not be successful in later nesting attempts due to a lack of brood water. What wet areas did remain on the refuge would receive extreme crowding of broods and hens resulting in disease potential and exposure to predation. This was observed in 1992 when adequate water was available to attract nesting birds in the early spring and summer, but insufficient brood water was available later in the summer. The remaining water areas of the refuge contained thousands of ducklings and flightless adult waterfowl crowded into relatively small areas. Based on experiences in 1992 and the judgement of Refuge biologists, in years in which permanent marshes are dry, waterfowl production may be reduced by 20,000 to 40,000 birds.

Molting Waterfowl - Declining water levels in July would be detrimental to molting adult waterfowl which congregate on Lower Klamath NWR's permanent emergent marshes to spend the 3-4 week flightless period. Complete drying of wetlands in July and August would require molting waterfowl to make extensive overland moves, thereby exposing the birds to increased rates of predation. In addition, as water levels in wetlands become shallow and concentrate birds, conditions become favorable for the spread of avian botulism. Losses approaching 50,000 molting mallards could be experienced if wetlands dry during the molting period.

Disease (Avian Cholera) - During years of water shortage, the potential exists for crowding hundreds of thousands of waterfowl into limited habitat areas creating conditions for the spread of avian cholera, a highly contagious disease. Losses of >30,000 waterfowl/year have occurred in the last 20 years with a full complement of wetland habitats. Additional losses may be expected if wetland reductions result in crowding of birds.

Disease (Avian Botulism) - Creation of extensive shallow mudflat regions as permanent wetlands dry in summer may increase the risk of avian botulism. Shallowly flooded habitats are susceptible to high sediment temperatures, ideal conditions for proliferation of the botulism bacteria and subsequent toxin production. Losses in recent years have ranged from 1,000 to 20,000 birds/year with a full complement of wetland habitats. Reduced wetland acreage in summer may result in crowding of birds and additional losses to this disease.

4.1.2 Economic Impacts

Under this Alternative, and assuming an "A" water delivery priority for refuge farmlands (lease lands and cooperative farm lands), the farming program is likely to continue. Economic benefits to the agricultural community dependent on the refuge farming program would be as described in Chapter 3. The reduction in wetland habitats that could not be recouped via curtailment of spring/summer irrigations may reduce visitor use of the refuges, resulting in an unknown loss of revenues to local communities. Under the current full farming and wetland habitat program on the refuges, visitor use is estimated to contribute $1.6 million to local communities.

4.1.3 Noxious Weeds

Noxious weeds on Tule Lake NWR are costly to control in farm operations, can reduce yields in agricultural fields, and displace native vegetation. As such the presence of noxious weeds can have economic and environmental effects. Under this Alternative, the area occupied by noxious weeds would remain unchanged from the present occupying primarily roadside, dikes and berms. Present agricultural operations on Tule Lake NWR keep noxious weed infestations to a minimum within fields. Noxious weed problems would be minimized under this alternative relative to Alternatives 2 and 3.

4.1.4 Soil Erosion

Soil erosion on the refuge is primarily confined to the winter and spring during periods of high winds. Harvested row crop acreage is especially susceptible because of lack of soil cover. Recent lease terms that require a cover crop on harvested row crop fields is expected to minimize this problem. In small grain areas, wind erosion is primarily confined to the spring cultivation period. Once crops have emerged, the potential for soil erosion declines sharply. To minimize soil erosion in small grains, the Service would continue to restrict fall work in farmed areas until just prior to cultivation. Potential for soil erosion, is greatest under this alternative because of the increased frequency of spring cultivation.

4.1.5 Recreation

A total of 2,084 waterfowl hunters used Refuge farm lands on Tule Lake NWR in 1997, a fairly typical year. During the 1970's, hunter numbers using these fields were 3-4 times greater; however, declining goose use on the refuge as well as a general decline in hunters in Oregon and California has resulted in a declining trend in waterfowl hunters. Under this alternative, the gradual decline in waterfowl hunters would likely continue. An increased risk of dry wetland habitats, principally on Lower Klamath NWR may result in a decline in non-consumptive wildlife users and duck hunters. Currently, approximately 200,000 persons use Lower Klamath NWR with most users being bird watchers, photographers, or general wildlife viewers.

4.1.6 Agricultural foods for waterfowl

Canada, snow, Ross, cackling, and white-fronted geese as well as mallards and pintails are the primary waterfowl species using farm lands on Tule Lake NWR. Geese use a combination of small grains and row crops (primarily potatoes) while ducks use small grains. Waterfowl use of the agricultural habitats on Tule Lake NWR are typically highest during fall migration for the above mentioned species. The agricultural lands are also used heavily used by snow and Ross geese during the spring migration.

Under Alternative 1 (No Action), the present pattern of waterfowl use Refuge farm lands would be maintained. Impacts to field feeding waterfowl on Tule Lake NWR would be minimized under this alternative relative to Alternative 2 and 3.

4.1.7 Public controversy

Continuation of the present agricultural program on Tule Lake NWR would likely be controversial among environmental interests, especially in years where farm lands received adequate water and wetland habitats receive an insufficient supply. Environmental issues on the refuges as well as in the Klamath Basin are increasingly gaining the attention of national environmental organizations. This alternative would be supported by local farmers and immediately adjacent communities (Merrill, Malin, and Tulelake).

4.2 ALTERNATIVE 2: Farming consistent with 1999 CD - Potential for mid growing season irrigation curtailment.

Under this Alternative, the initial decision to proceed with the leasing program would be made on or about February 10 after Service hydrologists with input from Reclamation had evaluated the predicted NRCS February 1st inflow forecast to Upper Klamath Lake at the 70% exceedance level in combination with Klamath River flows and Upper Klamath Lake levels identified in Reclamation's annual or long-term Operations Plan. A decision not to lease would be made if the February forecast indicated insufficient water was available for refuge wetlands or if lake levels and river flows had not been established within Reclamation's Operations Plans sufficient to make this water supply determination.

If the decision not to lease is made on February 10th, the decision whether to allow a farming program will be re-evaluated on or about April 10 with predicted inflows to Upper Klamath Lake from the NRCS April 1st inflow forecast at the 50% exceedance level. It is estimated that the probability of curtailing leasing is approximately 50% which would correspond to below average and dry water years (<500,000 acre-foot inflow to Upper Klamath Lake, April-September). More precise estimates can only be generated after Klamath River flows and Upper Klamath Lake levels are established via Reclamation's annual or long-term Operations Plan. The Service believes that eliminating April - September irrigations in the Tule Lake lease lands will make available 14,000 to 29,000 acre-feet of water (see Section 1.3.3) for use in Refuge wetlands. **Under this alternative and despite an earlier decision to proceed with the farming program, if NRCS inflow forecasts prove overly optimistic and significant water shortages to Refuge wetlands are likely, the Service will terminate leases prior to the irrigation season or curtail irrigation of the farm lands on Tule Lake NWR during the growing season to make water available to Refuge wetlands.**

To evaluate whether using the February 1st 70% exceedance value and the April 1st 50% exceedance value is the appropriate decision criteria, the Service looked at 35 years of record (1961-97, excluding 2 critical dry years). In 21 of those years (60%), leasing would not have occurred based on the February forecast; however, when using the April forecast, this decision would have been reversed in 6 years. Ultimately, leasing would not have occurred in a total of 15 years or 43% of the time. In 3 of these 15 years, when leasing would not have been allowed, ultimately actual inflow to Upper Klamath Lake exceeded 500,000 acre-feet despite a February or April forecast to the contrary. It is important to note, however, that these actual inflow values were always less than 600,000 acre-feet or at the bottom of the above average inflow category when shortages are likely to refuge wetlands (see Table 1.1 and 1.2). In this range of inflow, it is very likely that refuge wetlands will be short of water from traditional sources.

Conversely, leasing would have been allowed in 20 years (57%). In these 20 years, actual inflows to Upper Klamath Lake fell below 500,000 acre-feet (445,000-497,000 acre-feet) in 3 years (15%) meaning that a farming program would be authorized when water shortages to refuge wetlands would likely have occurred. Under Alternative 2, these are the years in which leases would be terminated or a mid-season water shut-off in the farming program would have occurred in order to salvage water (return flows) for refuge wetlands.

4.2.1 Biological Impacts to Refuge

Additional wetland acreage is critically needed in dry years and below average water years because of the anticipated loss of up to 13,504 and 16,233 acres of wetlands, respectively, on Lower Klamath NWR (Table 1.1) as well as significant reductions in wetland habitats on Upper Klamath and Klamath Forest NWRs as well as Shoalwater Bay and Squaw Point State Wildlife Areas, Alkali Lake, Aspen Lake, Round Lake, Sycan Marsh, and Swan Lake. This Alternative could make 14,000 to 29,000 acre-feet of water available to refuge wetlands, eliminating much of the projected water shortages depicted in Table 1.1 as well as the biological impacts described under Alternative 1 (No Action). For a description of impacts to agricultural foods for waterfowl see Section 4.2.6.

4.2.2 Economic Impacts

Under this alternative, if summer irrigations in the Tule Lake NWR farming program were eliminated, gross crop revenues of $14.5 million may be lost (estimate based on 1995 figures). Because revenues tend to provide a multiplier effect to local economies, actual impacts may be greater than the gross crop revenues would indicate. Using a February 10 decision date allows for an early decision date in years of well above average snow pack, thereby allowing for increased planning for growers. The later decision date of April 10 will make the planning of spring planting difficult. The potential for a mid-growing season irrigation shutoff would increase the risk of farming on Tule Lake NWR relative to the other alternatives.

4.2.2.1 Lease Revenues to TID - If agricultural leasing does not occur, payments of net revenues from the leasing program to TID may be eliminated. If farming was initially approved, the increased risk of farming on Tule Lake NWR, due to the potential for mid-season irrigation curtailment, may also reduce net revenues to TID. Based on 1996 figures, this loss may account for up to 8% of TID's budget. Potential losses of net lease revenues to TID are greatest under this alternative.

4.2.2.2 Lease Revenues to Counties - The Kuchel Act of 1964 (Public Law 88-567) stipulates that a portion of the net lease revenues from the farming program be paid to Modoc and Siskiyou Counties. Under this alternative, if leasing did not occur, Payments-In-Leu-of-Taxes to Modoc and Siskiyou Counties from the leasing program may be eliminated. In 1996, Modoc and Siskiyou Counties received $32,994 and $166,773 in leased-land revenues, respectively from a full lease land program. Total county budgets for Modoc and Siskiyou Counties were $17.2 and $57.2 million respectively, in 1996. Thus, leased-land revenue payments represented 0.18 and 0.29 percent of affected county budgets, respectively. Increased uncertainty in the Tule Lake NWR farming program, due to the potential for mid-season irrigation curtailment, may reduce bid prices for lease lots even if a farming program were initially approved, thereby, reducing revenues to Counties. The potential to reduce revenues to counties is greatest under this alternative.

4.2.2.3 Economic Impacts to Local Communities - Economic impacts to the tri-county area of Modoc, Siskiyou, and Klamath Counties is expected to be small because of the relatively small number of farmers and acreage devoted to the lease lands; however, economic losses to the communities of Tulelake, Merrill, and Malin may be greater. If leasing did not occur, a loss of approximately $14.5 million in gross crop revenues to these communities may occur. The potential for these impacts is greater than under the No Action Alternative. If farming did occur but irrigations were curtailed mid-season, some crops would be harvested (depending on stage of crop growth) resulting in some economic benefits; however, losses to growers would be high because of harvesting a reduced crop while paying for the full cost of crop establishment.

The potential to alleviate a portion of the water shortages to wetland habitats on Lower Klamath NWR will help maintain visitor use to the refuges. Visitors to Tule Lake and Lower Klamath NWRs are estimated to contribute $1.6 million to local communities.

4.2.2.4 Impacts to Individual Lessees - Impacts to individual farm operations will be highly variable depending on the reliance of each operation on the leasing or cooperative farming program. Farmers who are wholly dependent on the leasing program could see economic impacts. Presumably, these farmers would seek to lease private lands, increasing demand, and driving up private rent values. In 1997, a typical year, 57 farmers worked leases on the Tule Lake NWR lease lands.

Farmers who are not dependent on the leasing program may not be affected by this Alternative and may in fact see the rent and values of their own lands increase. The increased risk of farming the leasing program under this alternative (particularly with the potential for a mid-season irrigation shutoff) may increase the difficulty in borrowing money for agricultural operations on the lease lands.

4.2.3 Noxious Weeds

Noxious weeds on Tule Lake NWR are costly to control in farm operations, can reduce yields in agricultural fields, and displace native vegetation. As such the presence of noxious weeds can have economic and environmental effects. If the lease lands are not farmed, noxious weeds populations may expand rapidly into areas which are not cultivated, potentially necessitating weed control activities by the Service. Given the large acreage involved (up to 17,000 acres), this may require increased expenditures of staff and dollars by the Service. Stubble and straw in small grain fields and cover crops planted in row crop fields in the prior fall may reduce weed populations. The degree to which weed control may be needed will depend on the response observed. Increased weed seed densities in the soil may result in increased costs of production to growers in subsequent leasing years, potentially reducing lease revenues. In addition, increased weed seeds may spread to private lands via a variety of dispersal mechanisms; the irrigation system being the most likely. Noxious weed problems under this alternative are greater than Alternative 1 (No Action).

4.2.4 Soil Erosion

Depending on establishment of fall planted cover crops, soil erosion is expected to decrease if farming does not occur. If weed infestations occur in farm fields in the absence of farming, soil erosion should be lessened.

4.2.5 Recreation

If the lease land agricultural program did not occur on Tule Lake NWR, waterfowl hunter numbers are expected to decline by approximately 1,000 visits because of the reduced attractiveness of the agricultural lands in the League of Nations (Fig. 1.1) fields to fall migratory geese. Pheasant hunter numbers may increase if bird populations respond to increased weediness of the fields with increased production of young. Non-consumptive visitor use of Tule Lake NWR will likely be unaffected since, most visitors utilize the tour routes along the Sumps to view wetland birds.

The increased water made available to wetlands on Lower Klamath NWR will help maintain visitor use of the area (including both waterfowl hunters and non-consumptive wildlife users), currently estimated at 200,000 visitors/year. Visitors to Tule Lake and Lower Klamath spend approximately $1.6 million in the local communities.

4.2.6 Agricultural foods for waterfowl

Canada, snow, Ross, cackling, and white-fronted geese as well as mallards and pintails are the primary waterfowl species using agricultural areas on Tule Lake NWR. Geese use a combination of small grains and row crops (primarily potatoes) while ducks use small grains.

Based on analysis performed by Dr. Robert Frederick (see Appendix 2), it is likely that curtailing Tule Lake NWR farm irrigations will cause waterfowl to fly farther to reach agricultural food resources and ultimately result in smaller populations utilizing Tule Lake NWR. Based on Scenario 3 (Appendix 2), which most closely resembles conditions that may exist in agricultural lands following lease curtailment, if irrigations were curtailed, fall waterfowl use would decline by approximately 1.7 million use days and birds would forage approximately 5.4 miles farther than under current conditions. As an example of use-days, a loss of 1.7 million use days would equate to 28,000 birds for 60 days (28,000 x 60 days = 1.68 million use-days) or fewer birds for a longer period. This represents about 7% of the average year long waterfowl use of Tule Lake NWR.

Given these results, implementation of this alternative may increase the potential for waterfowl crop depredation on private lands if spring/summer irrigations on the lease lands are curtailed. These potentially negative effects to the Tule Lake waterfowl population must be weighed against the positive benefits accrued from using the 14,000 to 29,000 acre-feet of water in Refuge wetlands if a large acreage (Table 1.1 and 1.2) if these habitats were otherwise dry. This quantity of water could flood up to 9,354 acres of seasonally flooded wetland or 8,055 acres of permanent wetlands(or a smaller combination of each). This acreage of habitat is enough to provide food and space to hundreds of thousands of waterfowl of a multitude of species.

Although some species of waterfowl utilize agricultural crops, wetland habitats are crucial to the bird's existence. Geese use wetlands for roosting and to obtain supplemental food resources and mallards and pintails make extensive use of seasonal and permanent marsh habitats for a variety of food resources including aquatic invertebrate, submergent plants, and seeds. Other waterfowl species such as gadwall, green-wing teal, shoveler, redhead, canvasback, lesser scaup, cinnamon teal, ring-neck, common goldeneye, ruddy duck, bufflehead, and common merganser use agricultural lands rarely if at all. These species are dependent on a diverse array of permanent and seasonal wetlands to provide habitat and the variety of foods essential for survival, reproduction, and migration. In addition to waterfowl a multitude of other wetland birds such as ibis, herons, egrets, bitterns, rails, shorebirds, and terns are dependent on wetland habitat for food, survival, and reproduction. A variety of reptile, amphibian, mammal, and fish species are likewise dependant on wetlands. Chapter 3 details the importance of Refuge wetlands to a variety of wildlife species.

4.2.7 Controversy

The degree of change and the potential for economic impacts to local agricultural communities likely will make this Alternative unpopular locally. Environmental interests will likely support this Alternative because it places the water needs of wetland habitats and a diversity of wildlife species above that of agriculture on the refuges.

4.3 ALTERNATIVE 3 (preferred)**:** Farming consistent with 1999 CD - No mid-season curtailment in agricultural irrigations.

The rationale, methodology, and decision dates for Alternative 3 are identical to Alternative 2; however, they differ in that Alternative 2 provides for a mid growing season irrigation shut-off while Alternative 3 does not. **Thus, if the decision is made to proceed with farming on Tule Lake NWR under Alternative 3, agricultural operations will proceed normally for the duration of the irrigation season.**

To evaluate whether using the February 1st 70% exceedance value and the April 1st 50% exceedance value is the appropriate decision criteria, the Service looked at 35 years of record (1961-97, excluding 2 critical dry years). In 21 of those years (60%), leasing would not have occurred based on the February forecast; however, when using the April forecast, this decision would have been reversed in 6 years. Ultimately, leasing would not have occurred in a total of 15 years or 43% of the time. In 3 of these 15 years, when leasing would not have been allowed, ultimately actual inflow to Upper Klamath Lake exceeded 500,000 acre-feet despite a February or April forecast to the contrary. It is important to note, however, that these actual inflow values were always less than 600,000 acre-feet or at the bottom of the above average inflow category when shortages are likely to refuge wetlands (see Table 1.1 and 1.2). In this range of inflow, it is very likely that refuge wetlands will be short of water from traditional sources.

Conversely, leasing would have been allowed in 20 years (57%). In these 20 years, actual inflows to Upper Klamath Lake fell below 500,000 acre-feet (445,000-497,000 acre-feet) in 3 years (15%) meaning that a farming program would be authorized when water shortages to refuge wetlands would likely have occurred. Under Alternative 3, these are the years in which a mid-season water shut-off in the farming program would not occur, thus shortages to refuge wetlands could still occur with a full agricultural program.

4.3.1 Biological Impacts to Refuge

The 14,000 to 29,000 acre-feet of water made available to refuge wetlands would be enough to eliminate much of the wetland water shortages depicted in Table 1.1 and 1.2 as well as the biological impacts described under Alternative 1 (No Action). Additional wetland acreage is critically needed in dry and below average water years because of the anticipated loss of up to 13,504 and 16,233 acres of wetlands, respectively, on Lower Klamath NWR (Table 1.1) as well as significant reductions in wetland habitats that occur in these year types on Upper Klamath and

Klamath Forest NWRs as well as Shoalwater Bay and Squaw Point State Wildlife Areas, Alkali Lake, Aspen Lake, Round Lake, Sycan Marsh, and Swan Lake. For a description of impacts to agricultural foods for waterfowl see Section 4.3.6.

4.3.2 Economic Impacts

Under this alternative, if summer irrigations in the Tule Lake NWR farming program were eliminated, gross crop revenues of approximately $14.5 million (based on 1995 estimates) may be lost. Because revenues tend to provide a multiplier effect to local economies, actual impacts may be greater than the gross crop revenues would indicate. Using a February 10 decision date allows for an early decision date in years when the decision is made to proceed with the leasing program, thereby allowing for increased planning for growers. The later decision date of April 10 may make spring planting difficult, although it may allow the leasing program to proceed in a year when the decision on February 10 was to not lease. Because there is no potential for a mid-season irrigation shutoff under this alternative, economic impacts are less than Alternative 2.

4.3.2.1 Lease Revenues to TID - Under provision of the Kuchel Act of 1964 (Public Law 88-567) and a contract between Reclamation and TID, TID is entitled to 10% of the net revenues from the leasing program. If leasing and cooperative farming did not occur on Tule Lake, net revenues from the leasing program to TID may be eliminated. A relatively late decision date in April may further reduce net revenues to TID even if a full leasing program occurred. Based on 1996 figures, when Tule Lake NWR farming does not occur, this loss may account for up to 8% of TID's budget. The potential losses to TID are less under this alternative than Alternative 2 but greater than Alternative 1 (No Action).

4.3.2.2 Lease Revenues to Counties - The Kuchel Act of 1964 (Public Law 88-567) stipulates that a portion of the net lease revenues from the farming program be paid to Modoc and Siskiyou Counties. Under this alternative, if leasing did not occur, Payments-In-Leu-of-Taxes to Modoc and Siskiyou Counties from the leasing program may be eliminated. In 1996, Modoc and Siskiyou Counties received $32,994 and $166,773 in leased-land revenues, respectively from a full lease land program. Total county budgets for Modoc and Siskiyou Counties were $17.2 and $57.2 million respectively, in 1996. Thus, leased-land revenue payments represented 0.18 and 0.29 percent of affected county budgets, respectively. If leasing did occur, payments to counties would be more than under Alternative 2 because there would be no risk of irrigation curtailment during the irrigation season, hence lease payments would likely be greater. Potential loss of payments to counties under this alternative would be greater than under Alternative 1 (No Action).

4.3.2.3 Economic Impacts to Local Communities - If leasing did not occur, economic impacts to the tri-county area of Modoc, Siskiyou, and Klamath Counties is expected to be small because of the relatively small number of farmers and acreage devoted to the lease lands; however, economic losses to the communities of Tulelake, Merrill, and Malin may be greater. If leasing did not occur, a loss of approximately $14.5 million (based on 1995 estimates) in gross crop revenues to these communities may occur. The potential for these impacts is greater than under the No Action Alternative.

The potential to alleviate a portion of the water shortages to wetland habitats on Lower Klamath NWR will help maintain visitor use to the refuges. Visitors to Tule Lake and Lower Klamath NWRs are estimated to contribute $1.6 million to local communities.

4.3.2.4 Impacts to Individual Lessees - Impacts to individual farm operations will be highly variable depending on the reliance of each operation on the leasing or cooperative farming program. Farmers who are wholly dependent on the leasing program could see economic impacts. Presumably, these farmers would seek to lease private lands, increasing demand, and driving up private rent values. In 1997, a typical year, 57 farmers worked leases on the Tule Lake NWR lease lands.

Farmers who are not dependent on the leasing program may not be affected by this Alternative and may in fact see the rent and values of their own lands increase. The increased risk of farming the leasing program compared to Alternative 1 (No Action) under this alternative may increase the difficulty in borrowing money for agricultural operations on the lease lands. However, these effects would be less than under Alternative 2.

4.3.3 Noxious Weeds

Noxious weeds on Tule Lake NWR are costly to control in farm operations, can reduce yields in agricultural fields, and displace native vegetation. As such, the presence of noxious weeds can have economic and environmental effects. If the lease lands are not farmed, noxious weed populations may expand rapidly into areas which are not cultivated, potentially necessitating weed control activities by the Service. Given the large acreage involved (up to 17,000 acres), this may require increased expenditures of manpower and dollars by the Service. Stubble and straw in small grain fields and cover crops planted in row crop fields in the previous fall may reduce weed populations. The degree to which weed control may be needed will depend on the response observed. Increased weed seed densities in the soil may result in increased costs of production in subsequent leasing years, potentially reducing future lease revenues. In addition, increased weed seeds may spread to private lands via a variety of dispersal mechanisms; the irrigation system being the most likely. Problems with noxious weeds under this alternative are greater than Alternative 1 (No Action).

4.3.4 Soil Erosion

Depending on how fall planted cover crops became established in the previous fall, soil erosion is expected to decrease if farming does not occur. If weed infestations occur in farm fields in the absence of farming, soil erosion should be lessened.

4.3.5 Recreation

If the lease land agricultural program did not occur on Tule Lake NWR, waterfowl hunter numbers are expected to decline by approximately 1,000 visits because of the reduced attractiveness of the agricultural lands in the League of Nations (Fig. 1.1) fields to fall migratory geese. Pheasant hunter numbers may increase if bird populations respond to increased weediness

of the fields with increased production of young. Non-consumptive visitor use of Tule Lake NWR will likely be unaffected since, most visitors utilize the tour routes along the Sumps to view wetland birds.

The increased water made available to wetlands on Lower Klamath NWR will help maintain visitor use of the area (including both waterfowl hunters and non-consumptive wildlife users), currently estimated at 200,000 visitors/year. Visitors to Tule Lake and Lower Klamath spend approximately $1.6 million in the local communities.

4.3.6 Agricultural foods for waterfowl

Canada, snow, Ross, cackling, and white-fronted geese as well as mallards and pintails are the primary waterfowl species using agricultural areas on Tule Lake NWR. Geese use a combination of small grains and row crops (primarily potatoes) while ducks use small grains.

Based on analysis performed by Dr. Robert Frederick (see Appendix 2), it is likely that curtailing Tule Lake NWR farm irrigations will cause waterfowl to fly farther to reach agricultural food resources and ultimately result in smaller populations utilizing Tule Lake NWR. Based on Scenario 3 (Appendix 2), which most closely represents conditions that may exist in the agricultural lands, if irrigations were curtailed, fall waterfowl use would decline by approximately 1.7 million use-days and birds would forage approximately 5.4 miles farther than under a full agricultural program. As an example of use-days, a loss of 1.7 million use days would equate to 28,000 birds for 60 days (28,000 x 60 days = 1.68 million use-days) or fewer birds for a longer period. This represents about 7% of the average year long waterfowl use of Tule Lake NWR.

Given these results, it is likely that implementation of this alternative will increase the potential for waterfowl crop depredation on private lands if spring/summer irrigations are curtailed in the farming program. These potentially negative effects to the Tule Lake waterfowl population must be weighed against the positive benefits accrued from using the 14,000 to 29,000 acre-feet of water in Refuge wetlands if a large acreage (Table 1.1 and 1.2) if these habitats were otherwise dry. This quantity of water could flood up to 9,355 acres of seasonally flooded wetland or 8,055 acres of permanent wetlands(or a smaller combination of each). This acreage of habitat is enough to provide food and space to hundreds of thousands of waterfowl of a multitude of species.

Although some species of waterfowl use agricultural crops, wetland habitats are crucial to the bird's existence. Geese use wetlands for roosting and to obtain supplemental food resources and mallards and pintails make extensive use of seasonal and permanent marsh habitats for a variety of food resources including aquatic invertebrate, submergent plants, and seeds. Other waterfowl species such as gadwall, green-wing teal, shoveler, redhead, canvasback, lesser scaup, cinnamon teal, ring-neck, common goldeneye, ruddy duck, bufflehead, and common merganser use agricultural lands rarely if at all. These species are dependent on a diverse array of permanent and seasonal wetlands to provide habitat and the variety of foods essential for survival, reproduction, and migration. In addition to waterfowl a multitude of other wetland birds such as

ibis, herons, egrets, bitterns, rails, shorebirds, and terns are dependent on wetland habitat for food, survival, and reproduction. A variety of reptile, amphibian, mammal, and fish species are likewise dependant on wetlands. Chapter 3 details the importance of Refuge wetlands to a variety of wildlife species.

4.3.7 Controversy

The local agricultural community likely would favor this alternative over Alternative 2 as there would be no mid-season irrigation cut-off. However, the degree of change and the potential for economic impacts to local agricultural communities may make this Alternative unpopular locally. Environmental interests will likely support this Alternative because it places the water needs of wetland habitats and waterfowl above that of agriculture on the refuges.

CHAPTER 5: COMPLIANCE, CONSULTATION AND COORDINATION WITH OTHERS

On March 15, 1999, the Service issued to the public a "Draft Discussion Paper" which outlined the issue of water shortages to Refuge wetlands related to water consumption by the Refuge's agricultural program. As part of the Draft Discussion Paper, the Service requested comments and additional information from the public. A total of 88 correspondence were received. Of this total, 80 individuals supported Option 2 in the Draft Discussion paper and voiced their support for the concept of wildlife receiving first priority for water on the Refuge. One individual opposed Option 2 and 3 individuals voiced concerns about Refuge practices that were unrelated to the water issue. Three interest groups expressed support for Option 2 and 1 group expressed concerns over an unrelated Refuge program. To the maximum extent possible, all pertinent concerns were incorporated into this draft EA.

Shortly after release of the Draft Discussion Paper, TID filed a complaint against the Service over the addition of the "water language" to the 1999 leases. Shortly, thereafter the Service and TID entered into a stipulation which resulted in dismissal of the complaint without prejudice. The Service, in the stipulation, agreed to reconsider the "water language" in future years after reviewing information provided by TID and public comments received on the Draft Environmental Assessment (EA) (not yet released). Refuge staff have met with TID and their contractors on March 4, April 13, August 8 and September 27, 1999 to discuss the issue, share information, and clarify positions. In addition, a tour of TID lands and Lower Klamath NWR was conducted on May 12, 1999. In addition, TID provided comments to the Service on the Draft Discussion paper on April 20, 1999. TID primary comments centered on disruption of local economies, revenues to TID and local governments, loss of wildlife habitat, depredation of crops by displaced Refuge waterfowl, noxious weeds, and concerns over the legal authority to affect the action. To the maximum extent possible TID's comments have been incorporated into this Draft Environmental Assessment.

As a result of this process, TID provided to the Service their analysis of water use by the lease lands (Memo dated July 29 and August 17, 1999), comments on the Service's return flow analysis (memo dated August 17, 1999), and a description of their operations if the farming program on Tule Lake NWR were curtailed (draft memo, November 10, 1999) The Service responded to TID's August and July memorandums with comments via a letter dated September 13, 1999.

In addition to comments received by the general public and concerns raised by TID, the following groups/agencies have been notified regarding the purpose and need for the proposed action.

Tule Lake Growers Association	Lease Land Advisory Committee	California Waterfowl Association
Tule Lake Irrigation District	Oregon Natural Resource Council	National Audubon Society
U.S. Bureau of Reclamation	Lease Land Advisory Committe	The Wilderness Society
Ducks Unlimited		

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APPENDIX 1

Hydrologic Analysis

Irrigation Water Sources for TID

This analysis examines the sources of irrigation water for 1) the Tulelake Irrigation District (TID) and 2) the Refuge farm lands within TID for the period of record from 1989-1998. The analysis will determine the proportion of irrigation water for the lease lands that is directly diverted from Upper Klamath Lake (UKL) versus that coming from return flow. The question of irrigation source is critical to the location and availability of "freed up"water in the event that the refuge farming program is reduced or curtailed. Water directly diverted from UKL will remain in the lake to be distributed among all Project users if not used by the refuge farming program. Water from return flow that is "freed up" will end up or remain in Tule Lake, downstream of all Project users except the refuge. Potential benefits to the refuge are greater under the latter scenario.

The period of record was selected because there are no data available prior to 1989 for the lease lands. The period also reflects current water management and cropping patterns. Special emphasis will be given to the critically dry years of 1992 and 1994 since these were the only two recorded years in the history of the Klamath Project that agriculture received less water than needed. The Service assumes that these two years will be representative of the response by agriculture to Project shortages in the future. In order to examine irrigation water sources for the refuge farm lands, it is necessary to look at sources for TID first.

TID receives irrigation water from three main sources: UKL by way of the Klamath River; the Lost River; and return flow (both subsurface and surface) from upstream irrigation (mainly KID). At the Lost River Diversion Dam, the entire flow of the Lost River is diverted to the Lost River Diversion Channel (LRDC), except during very high flows. This water can be spilled to the Klamath River through the LRDC or it can be rediverted back into the Lost River downstream of the dam at Station 48. LRDC water is a mix of Lost River water and Klamath River water, plus whatever return flow has entered the system to this point. Diversions at Station 48, adjacent to the Lost River Diversion Dam, are said to represent the quantity of water ordered by TID from UKL, although in actuality, this is likely an overestimate because of the co-mingling of return flow and direct diversion. Station 48 diversions, along with net diversions/return flows entering the Lost River downstream of the dam, are delivered to TID at the J Canal and Anderson Rose Dam.

Diversions at Station 48 for the April-October irrigation season averaged 71,900 ac-ft for the 10 year period from 1989-1998. The maximum was 106,900 ac-ft (in 1994) and the minimum was 41,200 ac-ft (in 1998). April-October diversions at Station 48 during the critically dry years of 1992 and 1994 were 92,200 ac-ft and 106,900 ac-ft, respectively. These are the two highest values in the 10 year period of record.

Water at Anderson Rose Dam can reach TID either by being diverted to the J Canal or by passing through the dam down the Lost River to be subsequently diverted from Sumps 1A and 1B. The majority of the water supply for TID is diverted through the J Canal. Diversions at the J Canal are a combination of UKL water and Lost River water, supplied by Station 48, and return flow from upstream irrigation districts. Diversions at J Canal for the April-October irrigation season averaged 128,200 ac-ft for the 10 year period from 1989-1998. The maximum diverted was

143,900 ac-ft (in 1991) and the minimum was 101,300 ac-ft (in 1998). April-October diversions during the critically dry years of 1992 and 1994 were above average (134,700 and 137,500 ac-ft, respectively) The average April-October flow through Anderson Rose Dam for the 10 year period was 10,500 ac-ft, with a maximum of 15,200 ac-ft (in 1998) and a minimum of 5,200 ac-ft (in 1991). A 30 cfs flow is now required below the dam for at least four weeks beginning on April 15 for sucker spawning (a total volume of at least 1,700 ac-ft).

The total flow at Anderson Rose Dam (the sum of flow passing the dam plus flow diverted at the dam to the J Canal) reflects a combination of Station 48 deliveries plus any diversions/returns occurring downstream of the Lost River Diversion Dam to this point. Differences between Station 48 deliveries and total flows at Anderson Rose Dam indicate whether water is lost or gained in the river reach spanning these two sites. Comparisons of flows at these two sites show that for the entire period of record (1961-1998), downstream flows at Anderson Rose Dam have exceeded Station 48 deliveries from UKL during the April-October irrigation season. The additional water is assumed to be from return flows entering the Lost River between Station 48 and Anderson Rose Dam. Estimates of the volume of return flow, calculated from the difference between the total flow at Anderson Rose Dam and Station 48 deliveries, averaged 66,800 ac-ft (49% of the total April-October flow) for the 10 year period from 1989-1998. The maximum was 84,500 ac-ft (in 1990) and the minimum was 41,600 ac-ft (in 1994). In the critically dry years of 1992 and 1994, estimated return flows for the April-October season were 50,600 ac-ft (35% of the total flow) and 41,600 ac-ft (28% of the total flow), respectively. These values indicate that even in these two critically dry years, return flow was a considerable component of the water available to TID, both in terms of volume and percentage.

The proportion of return flow reaching Anderson Rose Dam varies through the season. Average return flows in April were about 44% of the entire flow. In May, the average increases to about 65% before decreasing back to about 39% and 42% for June and July. During August, September, and October, the percentages of return flows increase from 46% to 78% to 90%, respectively. In 1992 and 1994, while there was less return flow overall, the timing followed this same general pattern with a small increase in May and a much larger increase in September and October. This pattern is consistent with irrigation patterns on the Project. Early season diversions are used to meet crop consumptive needs, provide frost protection, and replenish soil moisture. Efforts to increase water storage in the soil profile result in low irrigation efficiencies and more return flows early in the year. As crop consumptive demand peaks in summer, this stored soil moisture is consumed. Irrigation efficiencies increase and return flows decrease. In late summer and early fall, irrigation efficiencies decrease and return flows are proportionately higher once again.

Additionally, TID receives and pumps return flow from KID lands to the north of the J Canal. This drainage occurs through four culverts that pass underneath the J Canal. This drainage has averaged 45,000 ac-ft annually over the last 10 years, with an average of 34,400 ac-ft from April-October. Monthly averages for the last 10 years are as follows: April - 2,300 ac-ft, May, 9,900 ac-ft, June - 8,900 ac-ft, July - 4,500 ac-ft, August - 700 ac-ft, September - 6,000 ac-ft, October - 2,200 ac-ft. This water is subsequently available for re-diversion.

The analysis of the total water supply for TID demonstrates that a considerable proportion (average 49%) of the water reaching Tule Lake and the J Canal during the irrigation season is return flow. This does not include return flow reaching TID below Anderson Rose Dam. Even in the critically dry years of 1992 and 1994 when shortages to agriculture occurred, return flows averaged over 30%.

TLNWR Farm Land Water Sources

The lands leased for farming consist of two areas on the Tule Lake NWR: Sump 3, and Sump 2 or the Southwest Sump. Sump 2 is 5,657 acres and Sump 3 is 11,275 acres.

Sump 3 is supplied by the North N Canal system, including the N-12 Canal. The North N Canal system receives water from several sources: Pumps 4, 5, 6, 12, and R; Tule Lake Sump diversions to the N-12 Canal; and J Canal spills to the North N Canal. Pumps 4, 5, 6, and 12 provide the majority of the water for the North N Canal system. These pumps collect return flow from areas north and east of Sump 3 (TID and possibly KID). Tule Lake supplies water to Sump 3 through Pump R and the N-12 Canal. The J Canal supplies water to the N Canal too. J Canal spills consist mainly of water diverted at Anderson Rose Dam but there is a component of return flow from D Canal, M Canal, and Pumps 7 and 24. Water is returned to Tule Lake from Sump 3 by way of Pumps 10, 11, and C.

For the April-October irrigation seasons from 1989 to 1998, Pumps 4, 5, 6, and 12 averaged 54,000 (or 74% of the total April-October supply to the North N Canal). Pumping volumes during the 1992 and 1994 irrigation seasons were 46,500 and 50,400 ac-ft (70% and 74% of the total supply to the N Canal), respectively. While Sump 3 received less water during the critically dry years of 1992 and 1994, there was not a significant reduction in the percentage of return flow from the pumps. These values can be considered to represent the minimum return flow component to Sump 3. The remaining 26% of the total water supply for the North N Canal comes from either J Canal or Tule Lake. The analysis of the total water supply for TID showed that at least 49% of the water diverted to the J Canal at Anderson Rose Dam during the irrigation season is return flow. Almost all of the water in Tule Lake is return flow. Given this, the actual percentage of return flow reaching Sump 3 through the North N Canal system is, in all likelihood, close to 90% or more.

The timing of return flow reaching Sump 3 throughout the irrigation season, as based on Pumps 4, 5, 6, and 12, is similar to TID as a whole. Return flows from the pumps are at a minimum in April (63% of the total inflow), increase to 79% in May, and then range from 69% to 79% for the Jun-Sept before declining to 74% in October. These percentages represent minimums since the timing of return flow in Tule Lake or J Canal inflows to the North N Canal system has not been considered in calculating the percentages.

Sump 2 is supplied by Tule Lake (Sump 1A and 1B) through the Q and R Canals. Tule Lake gets surface inflows from three sources: Pumps 2, 3, 9, 10, 11, 27, B, and C; Lost River spills at Anderson Rose Dam; and North N Canal spills at R and the radial gate. The largest fraction of inflow comes from the pumps along Tule Lake (average 69% of the total April-October surface

water inflows to the lake for 1989-1998). These pumps discharge return flow and winter runoff from irrigated lands to Tule Lake. As shown above, the Lost River spill was estimated to be about 49% return flow at Anderson Rose Dam and the North N Canal was estimated to be at least 90% return flow. The proportion of Lost River inflow and N Canal inflow to Tule Lake varies over the years although collectively, they have contributed an average of 31% of the April-October surface water inflows for the 1989-1998 period. If they are assumed to contribute equally to the lake, then a conservative estimate of the percentage of total return flow reaching Tule Lake (and subsequently Sump 2) also would be at least 90%. April-October deliveries to Sump 2 averaged 21,000 ac-ft for the 10 year period from 1989-1998. The maximum delivered was 25,500 ac-ft (in 1996) and the minimum was 17,400 ac-ft (in 1989). Deliveries for 1992 and 1994 were 20,400 ac-ft and 23,300 ac-ft, respectively.

Water Budgets for Sump 2, Sump 3, and Tule Lake

North N Canal System Water Budget

Farm lands in Sump 3 (11,275 acres) are served by the North N Canal system. Surface inflows to the North N Canal system are from several sources: return flow from pumps 4, 5, 6, and 12; diversions from Tule Lake at pump R and the N12 Canal, and J Canal spills to N Canal (Table 1.1). Average monthly surface inflows to the North N Canal system by source are shown in Fig. 1.1. Inflows from pumps 4, 5, 6, and 12 are the major component of surface inflows in all months (average 75% annually and 74% April-October). These pumps deliver return flow from private lands upgradient of Sump 3 to the North N Canal system. The total supply to the N Canal averages 83,330 ac-ft annually and 74,567 ac-ft April-October.

Surface outflows from the North N Canal system include pumps 10, 11, and C, which discharge from Sump 3 to Tule Lake, and spills from the N Canal itself at R, M radial gate, and a second radial gate (Table 1.1). Average monthly surface outflows by source are shown in Fig. 1.1. Spills from the North N Canal (R and the two radial gates) release water that is not diverted into Sump 3. Water that does make it to Sump 3 but is not consumed (either return flow or seepage) is pumped to Tule Lake through pumps 10, 11, and C.

The difference between total surface inflows and spills from the N Canal represent net inflows to the Sump 3. Net inflows include water deliveries and N Canal seepage that reaches Sump 3. The average annual net inflow to Sump 3 is 56,304 ac-ft, of which 86% (48,391 ac-ft) occurs in the April-October irrigation season. Net outflows from Sump 3 are represented by the total outflow from pumps 10, 11, and C. These pumps deliver return flow from Sump 3 and seepage from the N Canal or Tule Lake. The average annual net outflow (from pumps 10, 11, and C) is 35,288 ac-ft, of which 89% (31,424 ac-ft) occurs in the April-October irrigation season. Figs. xx.2 shows the average monthly net inflow and outflow for the period 1989-1998. The difference between net inflow and net outflow (21,016 ac-ft annually and 16,967 ac-ft April-October) represents losses or gains from other sources: precipitation inputs; changes in soil moisture; groundwater inputs and losses; and crop consumptive demand.

Crop ET was estimated independently by Service hydrologists, based on acreage and crop data

compiled from TID Annual Reports and reference ET and crop coefficients as determined by the University of California Intermountain Research and Extension Center at Tulelake, CA. Average annual crop ET in Sump 3 is 21,141 ac-ft with 20,490 ac-ft April-October (Fig. 1.2). If crop ET is included in the outflow from Sump 3, the water budget for the N Canal system balances on an annual basis. Including precipitation inputs to the system (average 0.91' annually) produces an excess of inflow over outflow and leaves some outflow unaccounted for.

Diversions from N Canal to laterals and farm turnouts in Sump 3 average 25,228 ac-ft annually. This is much less than the average annual net inflow to Sump 3 of 56,304 ac-ft but more than the estimated crop ET. About 31,000 ac-ft (403 ac-ft/acre) of water is unaccounted for annually in the N Canal. Estimates indicate that only about 200 ac-ft could be lost through evaporation. The Service assumes that this water is lost almost entirely to seepage from N Canal to Sump 3. Furthermore, this seepage is most likely responsible for most of the 35,000 ac-ft of outflow from pumps 10, 11, and C. The surface diversions to laterals and farm turnouts in Sump 3 (average 25,308 ac-ft) are assumed to be responsible for meeting the consumptive demand of the crops as well as generating return flow.

In the critically dry years of 1992 and 1994, the total supply to North N Canal was less than the average of 83,330 ac-ft (67,997 ac-ft and 75,185 ac-ft, respectively). But the percent of water from the return flow pumps was consistent with the annual average of 75% for the 10 year period (71% for 1992 and 75% for 1994). Return flows were still a considerable component of the water deliveries to Sump 3 even in these critically dry years.

Q and R System Water Budget

Farm lands in Sump 2 (5,657 acres) are served by the Q and R Canals. Both canals divert water from a single source: Tule Lake. The analysis of the lake shows that it is almost entirely supplied by return flow. Outflows from Sump 2 are from a single pump: pump 9. Average monthly surface inflows and outflows are shown in Table 1.2 and Fig. 1.3. The average annual inflow to Sump 2 is 22,364 ac-ft and the average annual outflow is 15,844 ac-ft. Almost all of the inflow and outflow (94%) occurs during the April-October irrigation season. The difference between inflow and outflow represents losses or gains from other sources: precipitation inputs; changes in soil moisture; groundwater inputs and losses; and crop consumptive demand. In the critically dry years of 1992 and 1994, deliveries to Sump 2 were close to the 10-year average of 22,364 ac-ft (20,891 ac-ft and 25,623 ac-ft, respectively).

Crop ET in Sump 2 was estimated using the same methodology as in Sump 3. Average annual crop ET is 12,198 ac-ft with 11,793 ac-ft April-October (Fig. 1.3). Average diversions from the Q and R Canals to laterals and farm turnouts in Sump 2 are 18,122 ac-ft. Approximately 4,000 ac-ft (235 ac-ft/acre) is unaccounted for annually from the Q and R Canals, a smaller rate of loss than N Canal. This water is assumed to be lost to seepage from the Q and R Canals to Sump 2 and is most likely responsible for some of the 15,844 ac-ft of outflow from pump 9. Surface diversions to Sump 2 (average 18,122 ac-ft) are assumed to be responsible for satisfying crop consumptive demand (average 12,198 ac-ft) and generating some of the outflow from pump 9. Surface diversions and seepage inflow are less than surface outflow and estimated crop

consumption by about 5,600 ac-ft annually. Precipitation inputs account for some but probably not all of this outflow. The excess of outflow over inflow may be due to measurement error or additional groundwater inflow in Sump 2 from an outside source. Interestingly, the water budget on Tule Lake itself suggests that groundwater may be recharging the lake as well.

Tule Lake (Sumps 1A and 1B) Water Budget

Tule Lake (13,021 acres) receives water from the Lost River via Anderson Rose Dam spills; N Canal spills; return flow pumps adjacent to the lake, and precipitation (Table 1.3). Sources of inflow to Tule Lake vary by season (Fig. 1.4). Return flow pumps are the largest source of water to Tule Lake, averaging 81,248 ac-ft annually, but most of this inflow (73,704 ac-ft) arrives during the April-October irrigation season. Most of the Anderson Rose Dam inflow (24,556 ac-ft) is outside of the irrigation season. N Canal spills (18,241 ac-ft) are almost entirely during the irrigation season. Precipitation is a relatively small component of inflow (13,095 ac-ft annually).

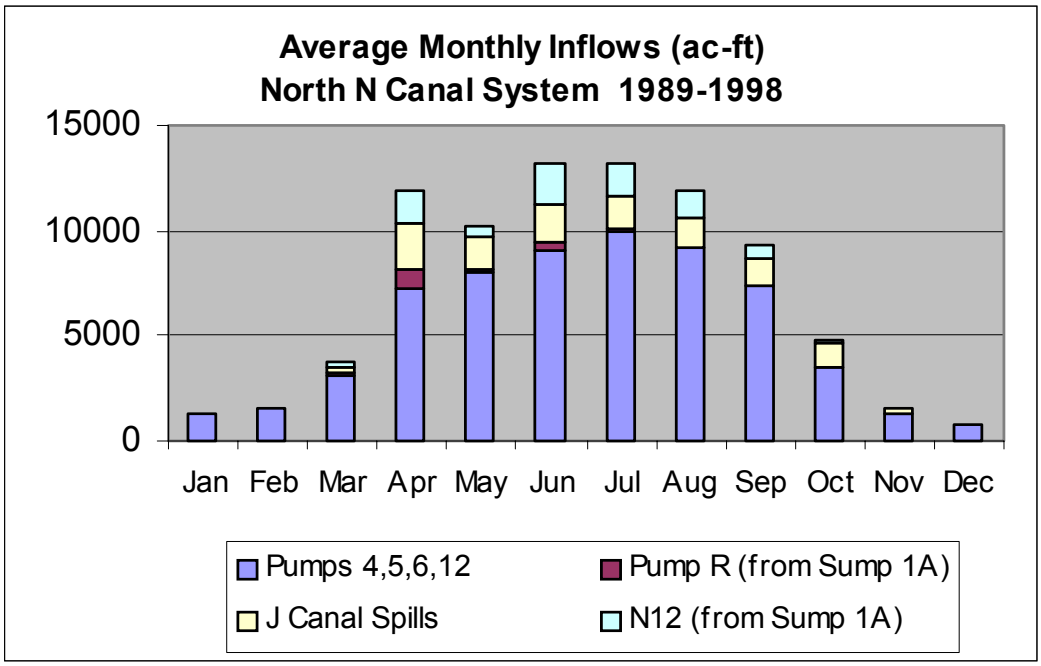
Outflows from Tule Lake include irrigation diversions through pumps R and 26, N-12 canal, and the Q and R canals; D Plant pump; and evaporation (Table 1.3 and Fig. 1.4). D Plant pump is the largest source of outflow from the lake (84,186 ac-ft annually and 51,321 ac-ft April-October). Evaporation is the second largest source of outflow at 50,055 ac-ft annually (Table 1.3). Irrigation diversions from the lake total 32,254 ac-ft, almost all of which occur April-October. Most of the irrigation diversions go to Sump 2, followed by Sump 3. Pump 26, a relatively small diversion, is the only delivery to private farm lands from the lake.

The difference between inflows and outflows in Tule Lake is significant. Outflows exceed inflows in all years (30,331 ac-ft annually and 21,151 ac-ft April-October). The difference may be due to measurement error or groundwater inflow. The monthly imbalance is not correlated with any particular measuring site or sites, as would be expected if the difference was due to a systematic measurement error at a particular site. Evaporation was estimated and not measured directly but the imbalance is not correlated with evaporation and the likely range in the evaporation estimate would not explain the entire imbalance. This suggests that unmeasured groundwater inflow may be responsible for the excess of outflow over inflow.

In 1992 and 1994, D Plant pumping from Tule Lake Sumps was far below the April-October average of 51,321 ac-ft, resulting in very limited deliveries for the refuge in those two years. Several factors are responsible for the decrease. In 1992, total April-October inflow to Tule Lake was 78% of the 10-year average. Inflow from the return flow pumps was 82% of the 10-year average of 73,704 ac-ft. Total April-October outflow from the lake for 1992 was about 70% of the 10-year average. D Plant outflow was just 28% of average (14,412 ac-ft) but evaporation losses (44,437 ac-ft) and farm deliveries (29,207 ac-ft) were about average. Some of the April-October inflow to the lake in 1992 went to storage. Lake storage increased by 12,761 ac-ft between April and October, presumably due to ESA minimum lake elevation requirements which became effective in July 1992. The increase in storage in the lake and as well as the full deliveries to the farm lands left very little excess water to be pumped through D plant. Even in this critically dry year, however, there was still an excess of outflow over inflow. April-October

outflow plus lake storage exceeded April-October inflow by 16,437 ac-ft. Without this excess, there may have been no D Plant pumping in 1992.

In 1994, total April-October inflow was 96% of the 10-year average for the same period. Inflow from the return flow pumps was slightly higher than the 10-year average. Total April-October outflow for 1994 was 78% of the 10-year average. D Plant outflow was 24,563 ac-ft, just 48% of average, while evaporation losses were slightly below average (40,500 ac-ft) and deliveries to farm lands were slightly above average (32,570 ac-ft). Storage in the lake only increased 1,953 ac-ft for the April-October period during 1994. Despite near average inflows, evaporation losses and farm deliveries, D Plant pumping was reduced considerably. This appears to be related to the fact that 1994 is the only year of the ten year record where total outflow and storage did not exceed total inflow for the April-October period. As mentioned above, April-October outflow plus lake storage has exceeded April-October inflow an average of 21,151 ac-ft for the ten-year period of record. In 1994, however, inflow exceeded outflow plus storage by 3,627 ac-ft for the same period. For whatever reason, the excess in outflow present most years did not exist in 1994. The importance of this surplus outflow can be seen by examining the following year. In 1995, April-October inflows to the lake were 98% of average, with only 2,000 ac-ft more inflow than 1994. For the same year, April-October outflow plus storage exceeded inflow by 16,070 ac-ft and D Plant outflow was 53,769 ac-ft, which is slightly above the 10-year average. The importance of this excess outflow to the lake budget and to D Plant pumping is evident.



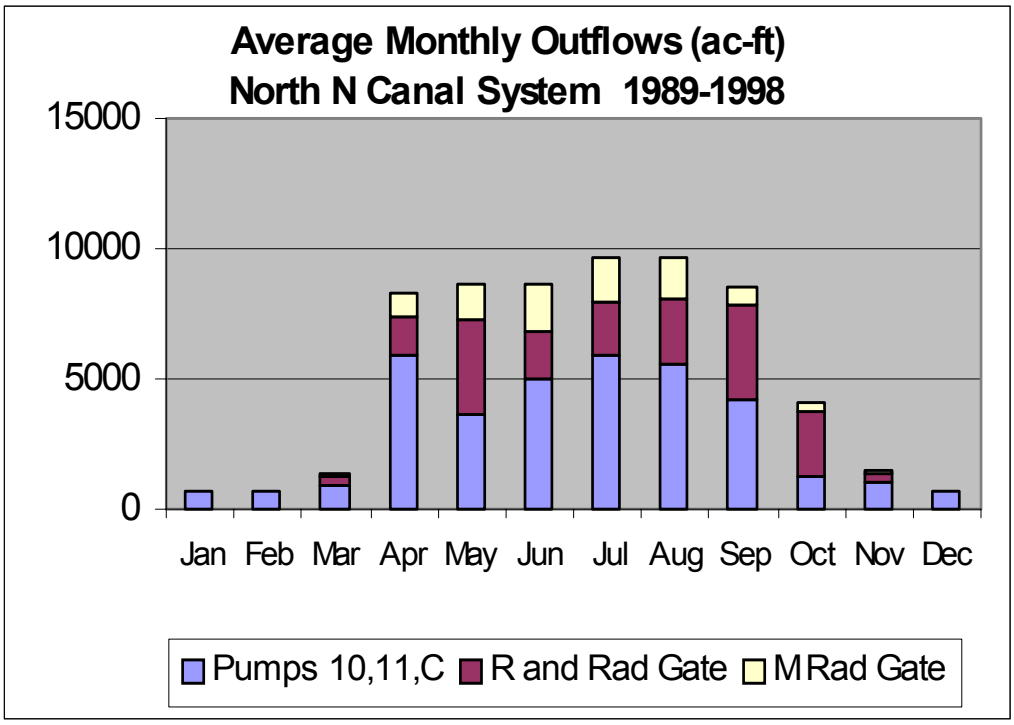
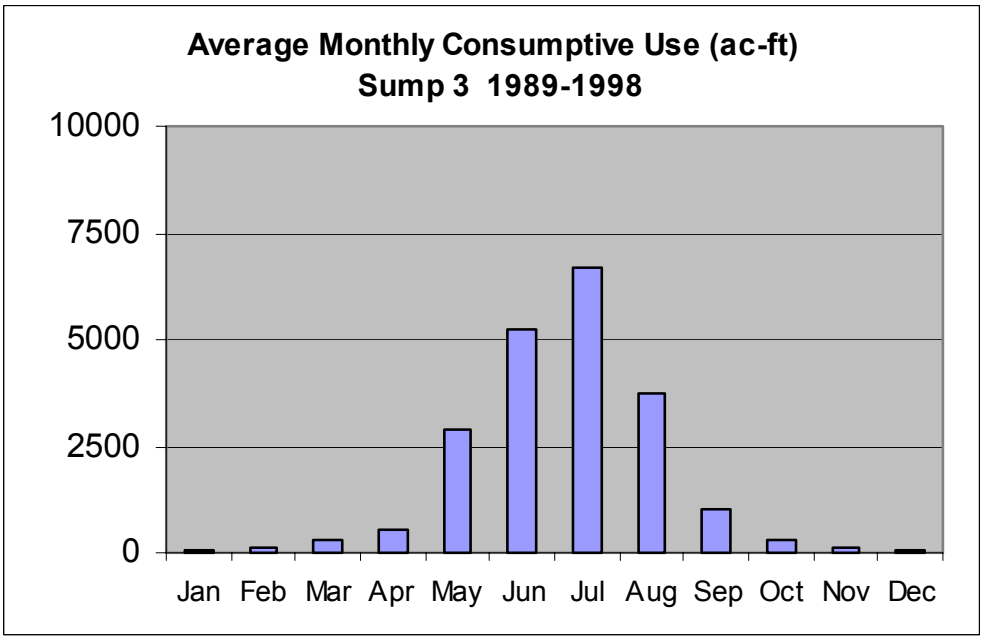


Fig. 1.1. Average monthly inflows and outflows in the N Canal system, Tule Lake National Wildlife Refuge, California, 1989-98.



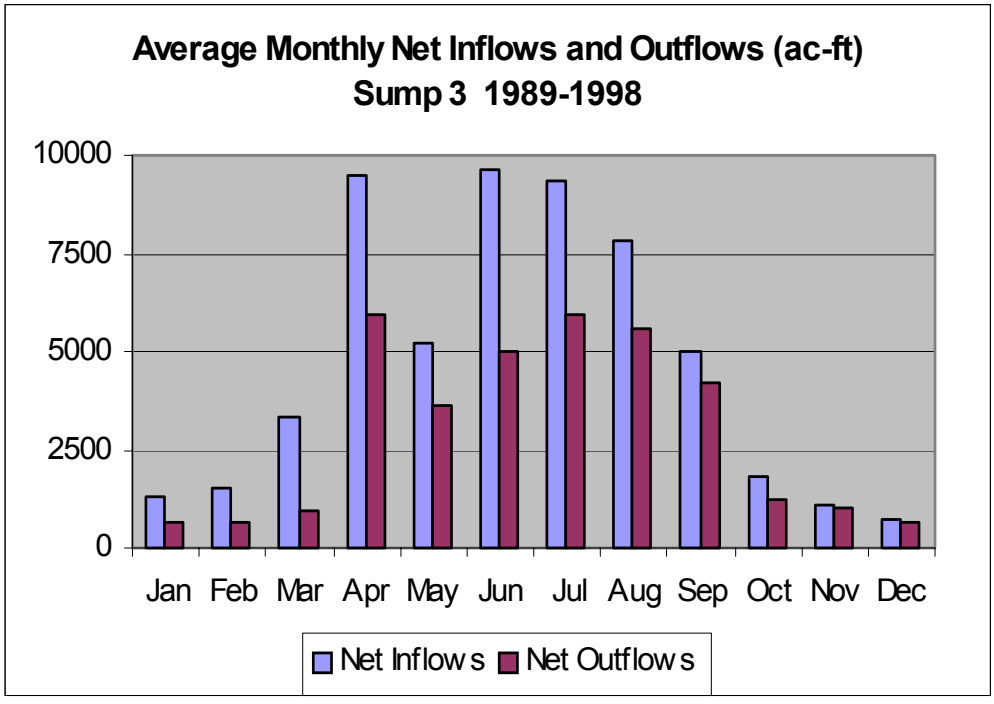
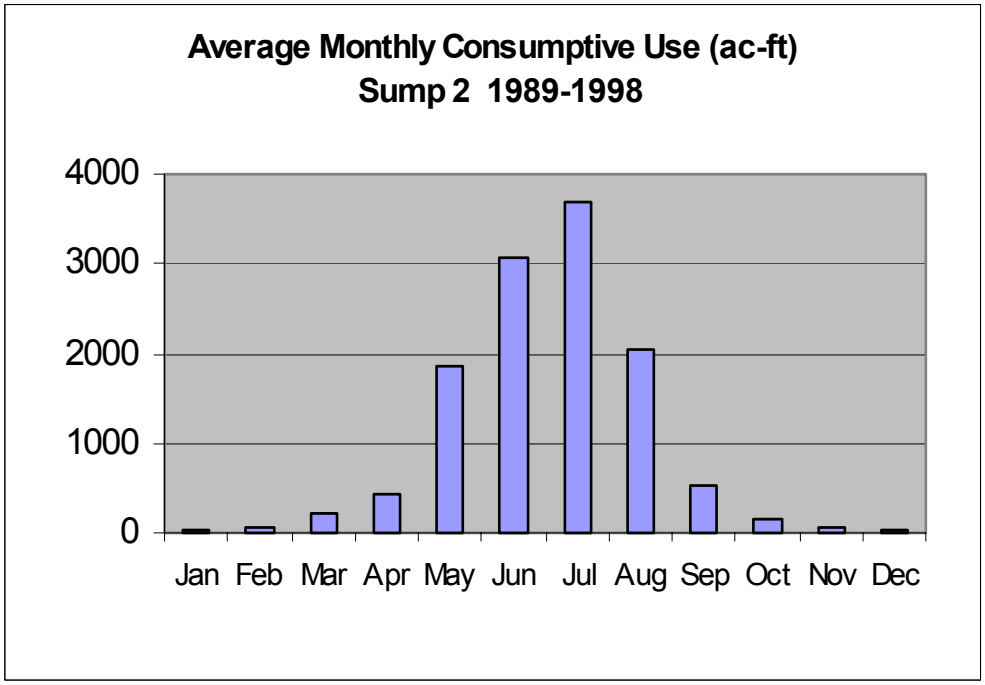


Fig. 1.2. Hydrologic data for Sump 3 on Tule Lake National Wildlife Refuge, California, 1989-98.



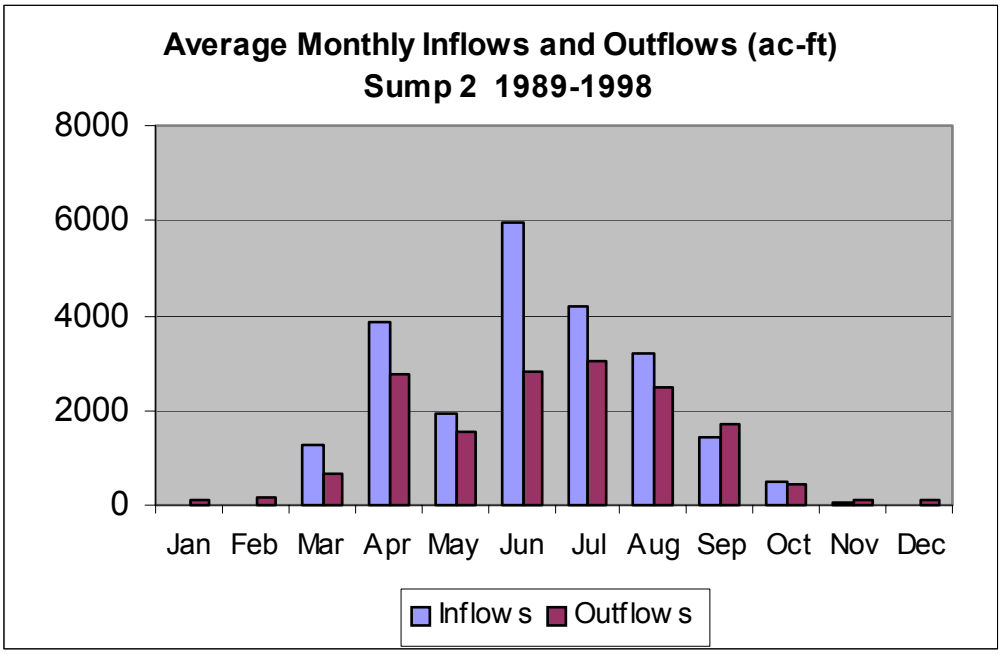
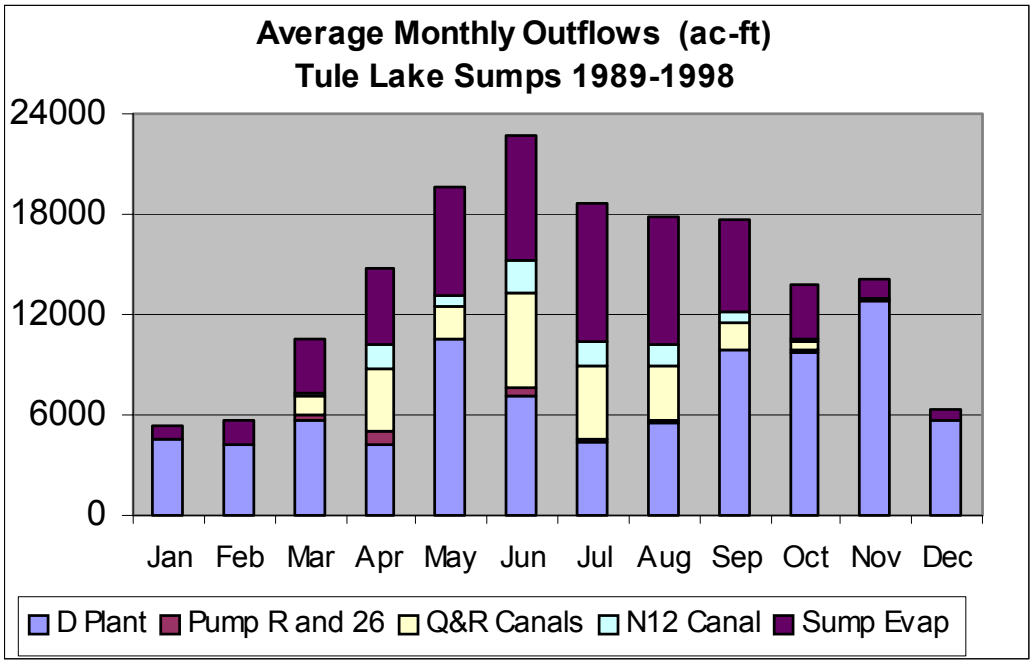


Fig. 1.3. Hydrologic data, Sump 2, Tule Lake National Wildlife Refuge, California, 1989-98.



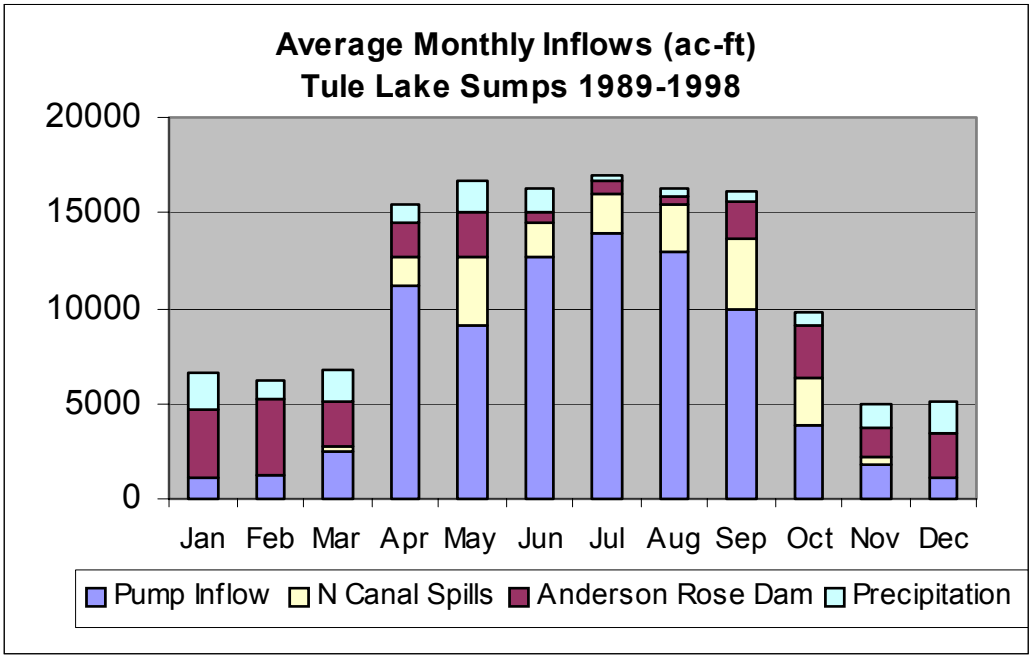


Fig. 1.4. Hydrologic data for Sumps on Tule Lake National Wildlife Refuge, California, 1989-98.

Table 1.1														
SUMP 3 - NORTH N CANAL														
1989-1998 average (ac-ft)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Apr-Oct
Pumps 4+5+6+12	1274	1509	3042	7299	8044	9076	9923	9125	7381	3487	1281	760	62200	54336
Pump R	0	0	180	911	67	315	157	69	12	21	41	0	1772	1552
J Spill to N	0	0	286	2126	1536	1864	1588	1469	1233	1111	192	0	11404	10927
N12 (from lake)	0	0	184	1570	628	1997	1489	1217	736	118	16	0	7954	7753
N total Supply	1274	1509	3692	11905	10275	13253	13157	11879	9362	4737	1529	760	83330	74567
(no spills removed)														
North N Net Inflow	1274	1509	3303	9495	5225	9657	9356	7821	5020	1818	1067	760	56304	48391
(R, rad gate, M gate spill removed)														
North N Supply	1273	1509	3581	11002	8815	11452	11393	10312	8667	4316	1464	760	74544	65957
(removed spill at M gate only)														
%(4 5 6 12)/total Supply	100.0%	100.0%	78.5%	62.6%	79.0%	68.9%	75.5%	76.7%	78.9%	74.1%	86.3%	100.0%	74.6%	73.7%
% N12+R/(total)	0.0%	0.0%	12.5%	19.1%	6.1%	17.1%	12.5%	10.9%	8.0%	4.9%	1.8%	0.0%	11.6%	11.2%
Avg N North Out														
10+11+C	627	646	940	5930	3634	4984	5909	5578	4168	1221	987	665	35288	31424
Spills at R and Rad Gate	0	0	279	1507	3590	1795	2038	2492	3647	2498	396	0	18241	17566
Pump M Radial Gate	0	0	111	904	1460	1801	1763	1567	696	420	66	0	8786	8610
Closure (Net In - Net Out)	647	863	2362	3564	1591	4673	3446	2243	853	597	81	96	21016	16967
(w/o pcp & ET)														
Avg Monthly ET	68	128	300	532	2878	5259	6713	3750	1040	318	98	56	21141	20490
Closure (In-Out)	579	734	2062	3032	-1287	-586	-3267	-1507	-188	279	-17	40	-125	-3523
(not considering pcp)														
Pcp (ft)	0.14	0.08	0.13	0.08	0.13	0.09	0.02	0.03	0.04	0.05	0.09	0.12	1.01	0.44
Pcp (ac-ft)	1621	912	1416	846	1431	1068	280	334	454	593	1044	1340	11339	5006

Table 1.2

SUMP 2 - Q&R CANALS														
1989-98 Average (ac-ft)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**	**Apr-Oct**
Q Headworks	0	0	893	2418	1256	3998	2799	2038	829	118	5	0	14355	13457
R Headworks	0	0	365	1431	673	1978	1390	1148	608	393	23	0	8010	7622
Total In	0	0	1258	3849	1929	5977	4189	3186	1437	511	28	0	22364	21078
Pump 9	92	140	643	2736	1519	2818	3042	2484	1710	436	138	89	15844	14743
Avg Monthly ET	39	73	205	435	1861	3060	3689	2062	519	167	57	32	12198	11793
Total Out	130	213	848	3171	3380	5877	6731	4545	2229	603	195	121	28042	26535
Closure (In-Out)	-92	-140	615	1113	411	3159	1147	703	-272	75	-110	-89	6520	6336
(w/o pcp or ET)														
Closure (In-Out)	-130	-213	410	678	-1450	99	-2542	-1359	-792	-92	-167	-121	-5678	-5457
(not considering pcp)														
Pcp (ft)	0.14	0.08	0.13	0.08	0.13	0.09	0.02	0.03	0.04	0.05	0.09	0.12	1.01	0.44
Pcp (ac-ft)	813	458	710	424	718	536	140	168	228	297	524	672	5689	2512

Table 1.3														
TULE LAKE SUMPS														
1989-98 Average (ac-ft)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Apr-Oct
Pump Inflow	1050	1221	2426	11202	9151	12639	13950	12970	9997	3795	1777	1071	81248	73704
Anderson Rose Dam	3706	3955	2422	1782	2247	620	656	404	1992	2805	1545	2422	24556	10506
Spill at R and Rad Gate	0	0	279	1507	3590	1795	2038	2492	3647	2498	396	0	18241	17566
Pcp Inflow	1872	1054	1635	977	1653	1234	323	386	524	685	1206	1547	13095	5781
Total In	6628	6229	6761	15468	16641	16287	16967	16252	16159	9783	4924	5040	137139	107557
Change in storage	3034	2096	1068	2435	2083	-2552	339	1003	1641	-1263	-8711	-260	1085	3685
(neg = decline in level)														
Total In - Storage	3594	4133	5694	13033	14558	18840	16628	15249	14519	11046	13635	5300	136163	103872
Avg Sump Elev	4034.14	4034.30	4034.48	4034.52	4034.73	4034.73	4034.62	4034.67	4034.80	4034.81	4034.37	4034.04		
D Plant Pumping	4567	4150	5740	4144	10506	7144	4339	5519	9889	9780	12759	5650	84186	51321
Pump R & 26	0	10	191	942	110	425	254	141	56	35	41	0	2205	1963
Q&R Canal	0	0	1132	3619	1934	5670	4282	3300	1495	534	129	0	22095	20833
N12 Diversions	0	0	184	1570	628	1997	1489	1217	736	118	16	0	7954	7753
Sump Evap	817	1541	3286	4502	6397	7476	8274	7617	5562	3325	1181	673	50055	43153
Total Out	5302	5701	10533	14777	19575	22711	18638	17793	17737	13792	14126	6323	166494	125023
Balance														
(In-Storage=Out)	-1709	-1568	-4839	-1744	-5018	-3872	-2009	-2544	-3219	-2746	-490	-1023	-30331	-21151
(neg= Out+Storage > In)														

APPENDIX 2

Potential impacts on white-fronted geese of different cropping patterns on Tule Lake National Wildlife Refuge

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July 15, 1999

The following narrative and tables are taken from the report "Potential impacts on White-fronted geese of different cropping patterns on Tule Lake National Wildlife Refuge" by Dr. Robert Frederick, Eastern Kentucky University. A copy of the complete report can be obtained from Klamath Basin NWR, 4009 Hill Road, Tulelake, California 96134.

Summary and Conclusions

Changes make to the original version of REFMOD and model inputs resulted in some changes in output, but these changes may have improved model validity. Adding other field-feeding waterfowl to model inputs as white-fronted goose equivalents caused changes in output consistent with competition, but most differences were not significant. Comparing several management scenarios to base simulations indicated project-wide habitat changes(e.g. fallow two-thirds of crops) had less impact than most changes made to refuge crops (two-thirds of refuge in small grains without potatoes). Eliminating all refuge farming including buffer strips, eliminating refuge farming but leaving 1,400 acres of buffer strips, and converting the refuge to two-thirds winter-irrigated-only small grains and one-third fallow had the greatest impact on white-fronted geese. Fallowing one-third to one-half of refuge lease lands, however, had no significant impact on output variables in simulations. Even complete elimination of Tule Lake Refuge farming activities had minimal impacts on white-fronted goose populations when accompanied by increased buffer strip acreage of unharvested grain, even when these fields were winter irrigated only.

The following cropping scenarios were provided to Dr. Robert Frederick, University of Eastern Kentucky for input to computer model REFMOD for predicting impact to field-feeding waterfowl on Tule Lake National Wildlife Refuge:

1. 1/3 potatoes, 2/3 small grains on refuge lease lands.
2. Same refuge cropping pattern as in 1964 (date of Kuchel Act)
3. Elimination of all refuge farming including buffer strips[1]
4. Elimination of all refuge farming except buffer strip.
5. 1/3 lease lands fallow, 2/3 small grains.
6. 1/3 lease lands fallow, 1/3 winter wheat at 400 lbs/acre[2] , 1/3 potatoes.
7. All lease lands in winter-irrigated small grains (one-half normal waste grain density)
8. All lease lands in spring/summer irrigated small grains (normal waste grain density).
9. 2/3 lease lands in winter-irrigated small grains, 1/3 fallow.
10. 50% of lease lands fallow, remainder in 1/3 potatoes and 2/3 small grains.
11. Sump 3[3], fallow, Sump 2 in 1/3 potatoes and 2/3 small grains.
12. Sump 2 fallow, Sump 3 in 1/3 potatoes and 2/3 small grains.
13. 2/3 of entire Klamath Project lands including 2/3 of refuge fallow.
14. 1/3 of Klamath Roject lands including 1/3 of Refuge fallow.
15. Eliminate all refuge farming except 2,2400 acres of unharvested[4] buffer strips[5].

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[5] Buffer strips consist of 1,400 acres planted specifically for waterfowl.

[2] Approximate unirrigated yield left unharvested.

[3] See Figure 1; map of Tule Lake National Wildlife Refuge lands.

[4] Winter-irrigated only, half left standing, and half chopped down to encourage feeding.

Table 3. Effects of 15 management scenarios on output from 100 Refmod simulations per scenario (see text for full description of each scenario). All runs were based on population data for white-fronted geese only.

	GUSE[a]				MAXR[b]			MEANWANT[c]			
Scenario[d]	Mean	SD		*P*[e]	Mean	SD	*P*	Mean	SD	*P*	
Base	5.79	1.65		2.98	0.54		275.8	32.2			
S1	6.55	2.17	*	2.66	0.56		275.8	40.2			
S2	6.19	1.55		2.90	0.55		259.9	34.7	*		
S3	4.59	0.93	*	7.75	1.15	*	346.8	43.9	*		
S4	5.08	1.01	*	6.93	1.13	*	315.4	32.8	*		
S5	5.10	0.95	*	4.51	0.92	*	296.3	25.1	*		
S6	6.77	1.96	*	2.75	0.57		262.7	41.3			
S7	5.22	1.12		5.11	1.01	*	310.1	34.0	*		
S8	5.41	0.86		3.94	0.68	*	289.7	32.7	*		
S9	5.00	0.91	*	5.59	1.02	*	319.8	34.4	*		
S10	5.87	1.72		2.99	0.61		273.2	33.8			
S11	5.24	0.99		5.31	0.72	*	296.7	36.1	*		
S12	6.47	2.02	*	2.61	0.58	*	267.4	31.5			
S13	5.98	2.14		4.08	0.91	*	278.7	32.1			
S14	5.82	1.89		3.20	0.68		274.8	31.8			
S15	5.92	1.25		3.94	0.75	*	264.8	28.8			

a. Cumulative total of daily white-fronted goose population (units = millions of geese) over the entire fall/winter season.

b. Mean maximum daily distance (mi) flown from the roost to feed.

c. Mean of daily WANT values, where WANT is the amount of food desired in kcal/bird based on the previous day's energy expenditure.

d. S1 - 1/3 potatoes, 2/3 small grains on refuge lease lands;
S2 - same refuge crop acreage as in 1964;
S3 - elimination of all refuge farming, including buffer strips;
S4 - elimination of all refuge farming except buffer strips;
S5 - 1/3 lease lands fallow, 2/3 small grains;
S6 - 1/3 lease lands fallow, 1/3 winter wheat at 400 lbs/acre, 1/3 potatoes;
S7 - All lease lands in winter-irrigated small grains (one-half normal waste grain density);
S8 - All lease lands in spring/summer irrigated small grains (normal waste grain density);
S9 - 2/3 lease lands in winter-irrigated small grains, 1/3 fallow;
S10 - 50% lease lands fallow, remainder in 1/3 potatoes and 2/3 small grains;
S11 - Sump 3 fallow, Sump 2 in 1/3 potatoes, 2/3 small grains;
S12 - Sump 2 fallow, Sump 3 in 1/3 potatoes and 2/3 small grains;
S13 - 2/3 of entire Klamath Project lands including refuge fallow;
S14 - 1/3 of Klamath Project lands including refuge fallow;
S15 - eliminate all refuge farming except 2,240 acres of unharvested buffer strips.

e. * indicates scenarios resulted in significantly different output for this variable compared to output from base input date (Dunnet's test, $P<0.05$).

Table 4. Effects of 13 management scenarios involving Tule Lake Refuge changes only on output from 100 Refmod simulations per scenario (see text for full description of each scenario). All runs were based on white-fronted goose population data including all other geese and Tule Lake Refuge mallards and pintails as white-front equivalent units[a].

	GUSE[b]			MAXR[c]			MEANWANT[d]		
Scenario[e]	Mean	SD	*P*[f]	Mean	SD	*P*	Mean	SD	*P*
Base	9.28	1.67		3.17	0.62		274.5	34.6	
S1	9.81	2.08		2.90	0.58		270.6	30.5	
S2	9.81	1.84		3.27	0.54		265.0	32.2	
S3	7.56	1.35	*	8.54	1.03	*	365.2	43.4	*
S4	8.32	1.22	*	7.70	1.30	*	326.0	32.7	*
S5	8.62	1.18		5.47	1.15	*	312.4	37.0	*
S6	10.76	2.42	*	2.79	0.52	*	266.0	38.4	
S7	8.20	1.25	*	6.00	1.29	*	335.3	50.9	*
S8	8.59	1.27	*	4.65	0.83	*	300.2	24.7	*
S9	8.27	1.39	*	6.64	1.32	*	339.3	43.2	*
S10	9.54	2.06		3.44	0.90		275.9	38.1	
S11	8.79	1.30		5.71	0.77	*	299.6	37.6	*
S12	10.00	2.97	*	2.79	0.65	*	272.6	35.6	
S15	9.51	1.40		4.98	1.06	*	285.7	39.2	

f. White-front units are as follows: mallard = 0.25; pintail = 0.125; cackling Canada goose = 0.5; all other geese = 1.0 white-front units.

g. Cumulative total of daily white-fronted goose population (units = millions of geese) over the entire fall/winter season.

h. Mean maximum daily distance (mi) flown from the roost to feed.

i. Mean of daily WANT values, where WANT is the amount of food desired in kcal/bird based on the previous day's energy expenditure.

j. S1 - 1/3 potatoes, 2/3 small grains on refuge lease lands;
S2 - same refuge crop acreage as in 1964;
S3 - elimination of all refuge farming, including buffer strips;
S4 - elimination of all refuge farming except buffer strips;
S5 - 1/3 lease lands fallow, 2/3 small grains;
S6 - 1/3 lease lands fallow, 1/3 winter wheat at 400 lbs/acre, 1/3 potatoes;
S7 - All lease lands in winter-irrigated small grains (one-half normal waste grain density);
S8 - All lease lands in spring/summer irrigated small grains (normal waste grain density);
S9 - 2/3 lease lands in winter-irrigated small grains, 1/3 fallow;
S10 - 50% lease lands fallow, remainder in 1/3 potatoes and 2/3 small grains;
S11 - Sump 3 fallow, Sump 2 in 1/3 potatoes, 2/3 small grains;
S12 - Sump 2 fallow, Sump 3 in 1/3 potatoes and 2/3 small grains;
S15 - eliminate all refuge farming except 2,240 acres of unharvested buffer strips.

k. * indicates scenarios resulted in significantly different output for this variable compared to output from base input date (Dunnet's test, $P<0.05$).